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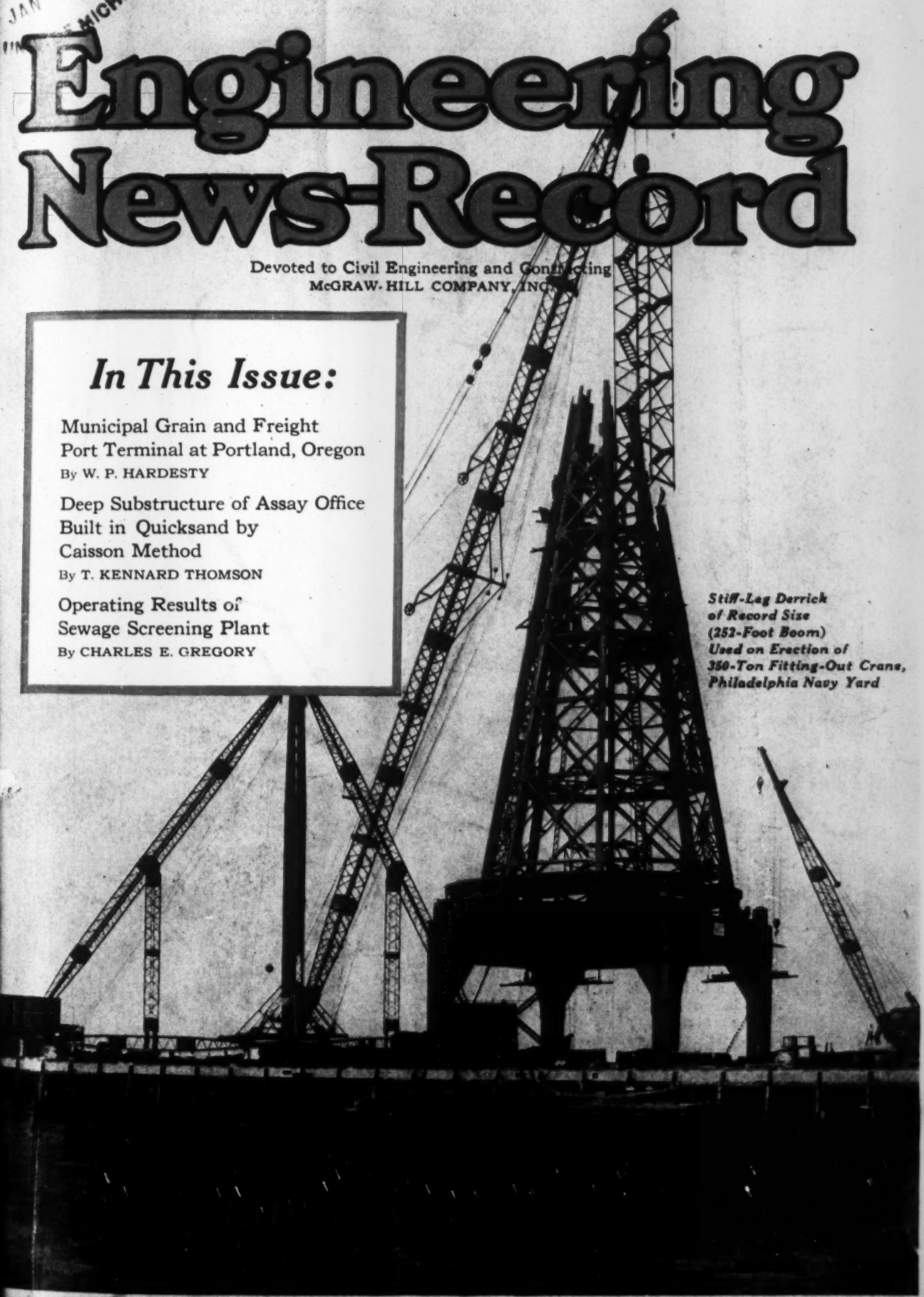

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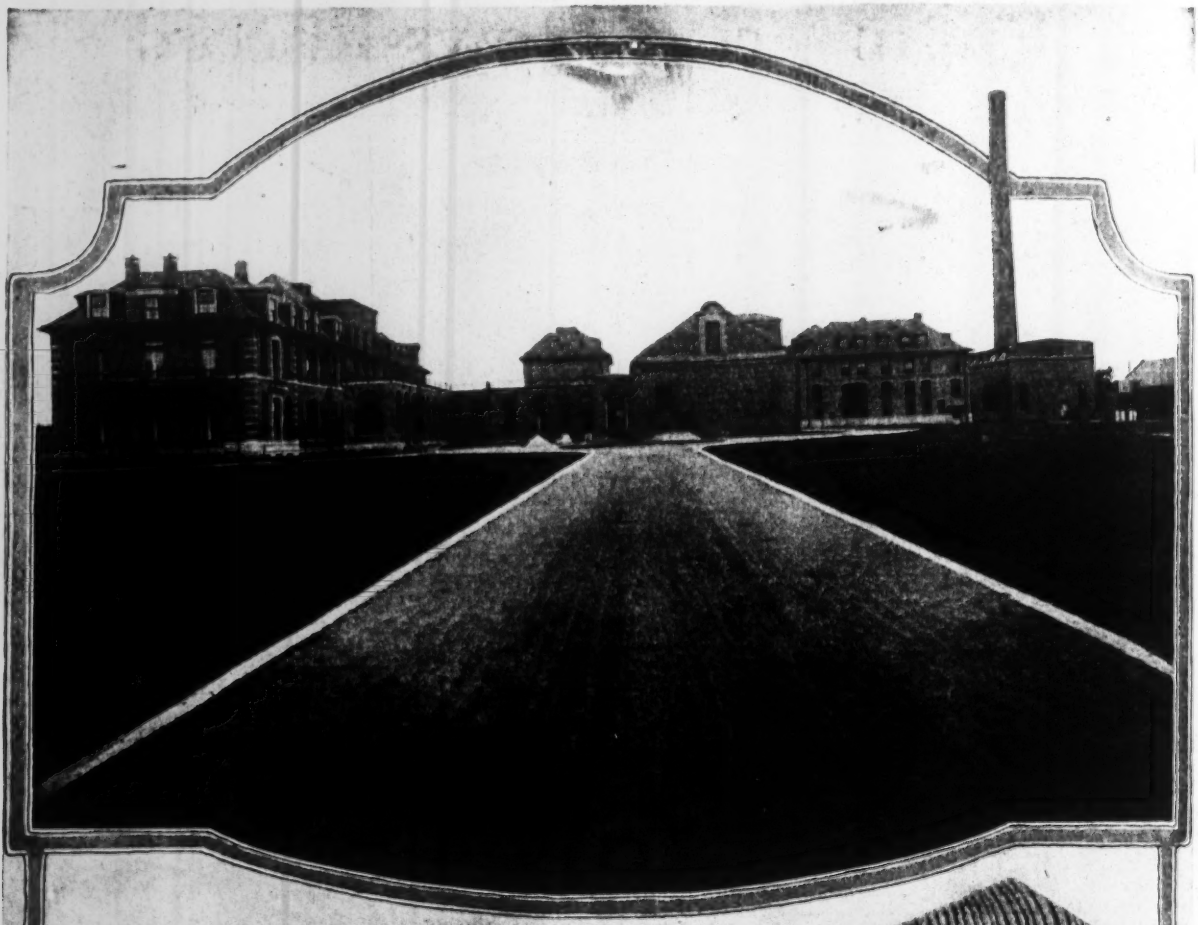

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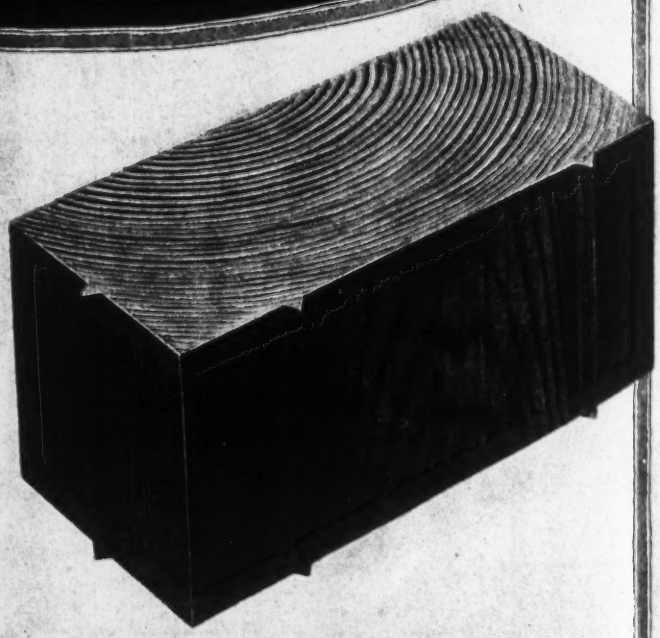

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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Richard C. Maclaurin

THE death of Dr. Maclaurin removes from the ranks of the profession a man whose career as a leader in engineering education developed at meteoric speed and whose future influence promised to be even larger than it was at his death. A mathematical physicist by avocation, he was called to the presidency of the Massachusetts Institute of Technology at a time when that school found its future hampered by inadequate plant. Dr. Maclaurin's vision, personal magnitude, and administrative genius were equal to the situation. The great buildings on the left bank of the Charles River were projected, financed and completed in a time so short that we still marvel at the accomplishment. True, he was fortunate in finding the mysterious "Mr. Smith," but had he not found him the new buildings would have materialized nevertheless, for Dr. Maclaurin's vision and personality were compelling. He would have found other means to build into enduring fabric the physical plant of which he dreamed. Nor must he be looked on solely as a great financial administrator. He was as truly a leader in engineering education. Preserving the sound traditions of the institute, he injected a new virility. Courses that broke new paths were introduced whenever there was a demonstrated need; those in business and engineering administration, in chemical and in aëronautical engineering are notable examples of courageous leadership in new fields. Such a leader the engineering profession could ill afford to lose.

Words of Promise from Philadelphia

A BROADMINDED view of municipal interests and responsibilities was voiced by Mayor Moore of Philadelphia last week when he urged the city council to appropriate money for the Camden bridge. He asserted that the city will derive great benefit from improved connection with its New Jersey suburbs and their outlying territory, and that on that account it ought to contribute to the construction fund. This view of the matter, natural though it be, contrasts strikingly with the view that has prevailed for years—for generations—in New York, where the same situation exists, with the Hudson in place of the Delaware. Commercial and political interests in New York City have always taken the attitude that the city should not participate in bridging or tunneling the Hudson, on the ground that such connection would benefit the New Jersey communities at the expense of New York. It is State money, not city money, that is to build the highway tunnel to Jersey City, soon to be started; and probably it will be State or else private capital that will undertake to construct a bridge across the Hudson, in the future, for the tradition that a city's growth must be halted at a State line is still powerful among New Yorkers. In time, the truer view taken by Mayor Moore will prevail generally. At present it is a most hopeful symptom of a growing concept of municipal responsibilities.

Hindsight vs. Foresight

THE COUNTRY might as well be prepared for several months of excited investigation of war extravagances. Exigencies of political strategy explain many things. Engineers and contractors are going to come in for more than their fair share of such criticisms as the Congressional investigating committees are called upon to make, because so large a part of the war expenditures in this country, at least, went toward construction. Comment as to the virtue of such criticisms must await a specific case. Although the armistice was signed in November, 1918, a canvass of the country in July of that year would have found about 95 per cent of our citizens betting on another year of war. This the critical Congressman choses to forget. With him hindsight rises superior to foresight. Because a certain plant, designed to supply munitions in the spring of 1919, never reached production, its designers are held up to public reproach. Apparently, any bright young man should have foreseen the eleventh of November. Such criticism carries its own answer and the engineers who are subjected to it should understand that they have the sympathy of their fellows.

Belgium's Recovery

ENCOURAGING, indeed, is the news that comes from Belgium regarding its industrial recovery. In a recent booklet on the subject D. L. Blount, recently director-general of the Central Office of Information, Ministry of Economics of Belgium, places the following estimates on resumption of industry: Coal mines, 94 per cent normal; refined sugar, 100 per cent; cotton spindles in operation, 75 per cent; cotton looms, 60 per cent; wool products, 75 per cent; shoes, 70 per cent; window glass, 34 per cent; plate glass, 36 per cent; steel mills, 30 per cent, while 12 blast furnaces are now producing 10 per cent of the output of the 54 blast furnaces in operation before the war. Of the machinery taken away during German occupation, 5,069 pieces out of 9,797 have been recovered. The agricultural production in 1919 surpassed the average for the years just preceding the war, the yield of wheat, oats, barley, and rye having been particularly good. In the light of the unfavorable reports current in the newspapers regarding conditions abroad, this showing of Belgium is very encouraging. It warrants the hope that a return to normal will not be as long deferred as we have been led to expect.

Pinch Piling Soft Ground

SOME of the complications of soft ground foundations are nicely illustrated in the Portland grain elevator case described on another page. The records indicate that the observed phenomena in pile driving were not sufficiently regarded during the construction of the foundations, and that there was undue confidence engendered by the high load carrying capacity of a single test pile. In a soft foundation such as this, a

single pile carries its load by a pyramidal distribution to its base, the slope of the pyramid depending on the cohesion of the soil and the friction between the soil and the pile. One pile, therefore, may distribute its load from the foot-square area at its top to an area of 25 sq.ft. at its bottom, thereby having a ratio of bearing to load of 25 to 1. In a group of such piles, however, driven side by side, the bearing areas intersect so that the ratio of load to bearing by no means remains the same as for the single pile. In a large foundation such as that covered by the Portland elevator the load is transmitted from the area of the footings to an area 40 ft. below the footings of a size increased only by the slope of the load on the outside row of piles. The bearing area, therefore, may be but slightly greater, say 10 or 15 per cent, than the loading area at the top of the piles, and the superiority of the pile foundation over a floating foundation of the same area is represented only by this proportion, provided the same soil conditions prevail throughout the 40-ft. depth.

Pinch piling such as was used in the Portland elevator helps by increasing the area at the base of the piles and thereby providing a lower unit loading by spreading the bearing area. There can be no increased bearing value in the piles due to friction except, as has been mentioned, that due to the small sloping of the load on the outer row of piles, nor will the pinch piling measurably increase the value of the foundations by compression of the soil between the piles, any more than the additional driving of piles, such as was resorted to in the Portland original footing, will help the bearing value, except insofar as it stiffens up the soil outside the footing area and thereby increases its friction angle and consequently the distributed bearing area.

At Portland the pinch piles act in effect as spread footings and have so reduced the unit load at their base as to make the loading safe at present. Just how much of the retardation or stopping of the settlement is due to this decreased unit bearing effect, and how much to the removal of the heavy hydraulic earth fill in the basement of the structure, time only will tell. The settlement will, however, serve to call new attention to the fact that piling is largely a device to transmit load from a soft soil to one of greater carrying capacity and that unless it reaches such a stronger stratum it tends to be a rather uneconomical form of spread footing.

Engineers and the Public Works Department

NINE months ago a group of engineers met in Chicago to plan a campaign which would result in the coördination of all engineering functions of the Government in one great Department of Public Works. The occasion was significant, not so much because of the purpose of the meeting, though that is entirely desirable and laudable, but because it was the first time that the whole engineering profession had joined, without regard to special society affiliations, to contribute to the improvement of national conditions. It was a step toward a professional integration which has long been sought and which must be preliminary to any improvement in the much discussed "status of the engineer."

Last week the successor to that group met in Washington to take stock of the progress of the campaign. The reactions were generally optimistic. Representatives from at least 100,000 engineers from every section of the country reported widespread approval among engineers of the proposed Governmental reform and a not unfavorable attitude of members of Congress who had been approached. Criticism of the main features of the proposed bill formulating the department were practically negligible; indeed, it was hinted that some definite opposition would be desirable. And yet it cannot be denied that the movement is languishing; its failure is imminent from the cause that underlies so many good movements—lack of funds.

This prospective failure is something that concerns all engineers; its occurrence would discredit the profession. If there were any considerable opposition to the Department of Public Works idea among engineers or if there were any pronounced objection to the present campaign voiced by engineering societies, the situation would not be so clear. With the entire profession approving the plan, the collapse of the Public Works Department campaign would be a lamentable display of weakness. It would be a blow to engineering morale from which there would be no early recovery.

There may be many reasons why the engineers cannot reform the Government of the United States, but it should not be for the lack of the $90,000 that will be required to finance the Public Works Department propaganda for the next year. Every society represented in the association should realize that; every one should appreciate the convention's clear-headedness in rejecting the proposed establishment of individual memberships at $5 a year—it would only take 18,000 members—in favor of the present society representation. The organization of the association is loose, but it is good and it should be effective. With the responsibility for raising its quota upon every State delegation, money-raising activities become centered. For the credit of the profession each center must do its duty.

One other development of the Washington meeting presents some complications. That is the very evident desire of the backers of the movement to extend its scope so that it will include, either now or in a not too remote future, the efficient reorganization of the United States Government. Such an enlargement of the association's field may be suggested by practical reasons, for some who are not engineers will lend their support if a wide reform is attempted. Such a broadening of scope seems to us undesirable. Instead, we should shape our appeal to make the business man and the general taxpayer see how they are to be benefited by the economies to be effected by the organization of a Department of Public Works. Obviously it will be proper to indicate that the formation of a department having such a logical and consistent basis would be but the first step in a general reorganization of the Government's executive departments, but the association should not pledge itself to carry the reform beyond this first step of putting all of the engineering and public-works activities together.

Moreover, if the Public Works Department Association were to set itself up as the destroyer of governmental inefficiency it would have to present greater claims to knowledge of governmental affairs than was displayed at Washington. It must have no doubt as to where the Bureau of Education belongs, and it must not so much as countenance a suggestion that a Federal insane asylum be put under the jurisdiction of that fiscal abnormality, the District of Columbia. So long as it professes only to coördinate engineering activities, it can shift responsibility for other branches of the Gov-

ernment, but once it got outside that field it would lose the confidence of Congress if it did not have definite knowledge and defendable opinions on the great machine which it essayed to overhaul.

Engineer-Managers in the Operation of Irrigation Works

MANY irrigation projects, both public and private, have now been completed. A few are in the hands of engineer-managers, and the number so handled is rapidly increasing. The former days, when a likely farmer might become a ditch rider, and in turn might work up through a watermaster's position to that of manager of the project, are rapidly disappearing. Technical men are coming into their own in the supervisory positions. Attendance recently at a water commissioners' meeting presided over by a former well known consulting hydraulic engineer as the executive head, convinced the writer more than ever that this is true. Almost every problem that was discussed, from the exchange or purchase of stored water to the adjustment of the minor complaint of a farmer as to non-receipt of what he considered his full quota of water, was handled expeditiously, without friction, because the facts were primarily engineering ones and the engineer had supporting data practically carrying its own decision.

Engineers and designers of new projects will benefit materially from having their work handled understandingly by engineers, and a rapid development of standards should accrue to the profession. Added support will be given to assumptions made in designs. The United States Reclamation Service is now standardizing small structures found in operation to be successful and satisfactory. A 10-in. pipe turnout and gate through an earth embankment, henceforth, need not be redesigned by every new batch of civil service recruits. Sluice gates, weirs, drops and like minor structures have been changed in small operating details by the engineer-managers of the Reclamation Service until the production of "shelf hardware" standards is now possible. Much more work in the standardization of larger structures and in the way of doing things and meeting recurring problems will be done if engineers are employed. Knowledge of what does and does not work, set forth by engineers on a given project, should save managers of other projects much work and obviate many difficulties, at the same time reducing operating costs.

Hydrographic problems on a project are largely engineering. Apportionment of water in accordance with evaporation can best be made by engineers. They can also best determine ditch losses, soil conditions, depth and general subsoil porosity, ground water levels, the rate of draining and all seepage difficulties. And danger of drowning out can be predicted by engineers several years before actual drowning out occurs, so that precautionary measures can be taken well in advance. Land that is producing at its maximum can easily stand the seepage safely factor cost. The operator is the one who should recognize the need for drainage first and spread the propaganda for action long before actual damage results.

Control of supply becomes more and more distinctly an engineer's problem because, with development to capacity, conservation of every portion must be observed most scrupulously. No sites for the storage of water are available at such ridiculously low figures as those of the past. In consequence, stored water hereafter will be required to do its full duty. Apportionment in accordance with priorities and requirements is becoming an absolute necessity. Only the engineers can do it scientifically and hence satisfactorily. Just how is water delivered? What will be the total supply for the season? How much can the farmer expect if there is a shortage? In many cases one-half and one-third or less "heads" were available in 1919 than usual. Prognostications based on engineering data of rainfall, snowfall, runoff and actual storage will be credited far more and can be acted upon more coöperatively than the guesses of the non-scientific farmer, politician, or business type of man heretofore occupying the managerial positions in canal companies or elective watermaster jobs in irrigation districts. Engineers in other lines owe it to the profession to encourage the pioneers who enter operating positions, and should support them in every way possible.

Filling the Vacancy of Chief of Engineers

THE announcement of the nomination of Colonel Lansing H. Beach as Chief of Engineers, United States Army, comes as a disappointment to those who confidently expected that the selection of the new head of the Corps of Engineers would be based upon demonstrated capacity for leadership in engineer operations in modern warfare, as shown by actual service with the American Expeditionary Forces in France. If such standards had governed, the former chief engineer of the A. E. F., Major-General W. C. Langfitt, would have been chosen as the new Chief of Engineers. The highest honor which can be bestowed upon an officer of the Engineer Corps, therefore, goes not to a man who performed brilliant service in the theater of operations during the late war, nor to a man who, at Washington, played a conspicuous part in the organization and administrative work necessary to back up the efforts of our combatant forces, but to a man who, throughout the period of hostilities, was engaged in the usual river and harbor work. Let it be understood that the foregoing comment is in no way a reflection upon Colonel Beach; he is a soldier, and obeyed orders as to his assignment during the war, just as he now obeys orders in becoming Chief of the Corps.

With reference to the promotion it should be noted that the seniority rule was broken in naming the new Chief of Engineers. In the natural succession Colonel F. V. Abbot would have been the nominee. The argument cannot be advanced in support of the appointment just made, therefore, that it was necessary to follow precedent by promoting the man at the top of the list, for Colonel Beach was No. 6, a single number above Colonel Langfitt in the roster of colonels.

The case, however, is one with a far broader significance than the mere promotion of an individual. The real issue is one of principle. There could be no excuse for breaking the seniority rule except to appoint the best man, but the inference to be drawn from the War Department's nomination is that war service, presumably the supreme test of an officer's ability, is to be disregarded. Rumor in Washington has it that in making the selection Secretary Baker was actuated by a desire to side-step what might become another item in the March-Pershing controversy, but that does not change the fact.

The corps would have been the better, in our judg-

ment, for the appointment of a man of the broadest experience in that for which the corps is primarily organized—the study, and, when necessary, prosecution of military engineering work.

River Regulation in a New Aspect

IN NO single field of civil engineering is development so pronounced as in flood protection. It was one of the very few subjects of public-works construction to grow into prominence during the disturbed five years of world war. Now, with the new year, it holds out promise of great coming activity.

Its prominence must be credited largely to the exemplary work for the protection of the Miami Valley, though the discussions and planning elsewhere, as at Columbus and Erie, no doubt contributed to the result. But the underlying factor is economic necessity, the essential importance to well-ordered communities of preventing the destruction and business disruption caused by recurring floods. Recognition of this necessity grew as the magnitude and frequency of the losses impressed themselves upon ever wider circles of the public.

Hitherto several distinct causes tended to hamper the development of flood protection. Losses being infrequent and irregular, any single impetus to the building of protective works was not maintained long enough to assure their execution, in the absence of a sufficiently wide appreciation of the issues involved. In most cases either the problem or its solution was regional rather than local. Means for securing regional action were wanting. The legislative status of the subject was unsatisfactory, a condition now being remedied by new legislation or the better administration of existing laws. Even locally, the fact that losses were confined to small parts of a community proved hampering, for the effect of such partial losses on the community as a whole was commonly ignored. And, not least important, there was the fact that streams were not (and still are not) definitely under one—or any—jurisdiction. All these hampering causes are being removed or rendered ineffective as general interest in the subject extends.

Simultaneous with this growth of interest, there is coming about an active appreciation of the wide range of problems presented by flood losses and their prevention. It is axiomatic today that no fixed formula or device is capable of fitting the remarkable diversity of conditions encountered in flood-protection planning. The great differences in hydraulic stream character would alone make each individual case a new one; but, superimposed on these are equally momentous variations in topography, in rainfall, runoff and concentration, and in the values at risk as well as in the distribution of these values among the flood contours. It is obvious that in general no approach to a solution can be made until all of these elements have been investigated. Yet this was not adequately realized until recently. It is only slightly extravagant to say that an inversion of method in attacking flood problems has come about: that some years ago it was common to attempt to adapt a flood stream to a particular type of preventive or protective construction, whereas now it is known to be necessary that constructional types singly or in combination be selected according to the specific dictates of the physical conditions. This is an important advance.

An even greater advance of thought is bound to grow out of flood studies, however. When they are viewed from the standpoint of flood protection, rivers and river regulation will appear in a quite new aspect. Streams will come to be regarded as hydraulic and hydrological entities, each of which in all of its characteristics concerns the community taken as a whole. Following this a new meaning will attach to river regulation; namely, that it is the administration of a stream as an entity.

In the past the relation of the public to a stream has apparently been fractional and incomplete. The stream was looked upon as a source of water supply, or as a drainage channel, or as a source of power or an agency of destruction, or as a means of navigation. It was under divided jurisdiction, moreover, and commonly under no particular jurisdiction. Because of this habit of view, it was possible for such accidents to happen as the Black River flood in Wisconsin, a case in which river utilization was planned from a single viewpoint and others neglected, with calamitous results. Because of this same view, river regulation remained a virtually nonexistent activity, except for the scattered and "single-track" work of the War Department. It was thus possible for the Government to spend many millions for improving a stream within its low-water width and at the same time ignore deliberately all river effects above the low-water shore line. In fact, the traditional view was nowhere so seriously faulty as in its effect: it tended to paralyze all initiatory action for improving or utilizing rivers.

Responsibility for this unfortunate condition rests in large part, we think, on Congress and the War Department; the former for assuming absolute control over the navigation function of rivers and failing to take account of or allocate jurisdiction over other functions; the War Department for administering its control narrowly in the interests of navigation. The fault lies, indeed more in the administration than in the law, for in spite of the narrow mandatory provisions of the law a reasonably liberal interpretation would have extended its application to many other purposes as being necessarily involved through their intimate connection with the main one.

River control, as a whole, is in its infancy, relative to other engineering subjects. It is certain to grow as the navigation view of river administration becomes less dominant. The time for the supremacy of this view is over. We believe that the view which will develop and lead to progress is that river administration is the responsibility of associated localities or regions, and that its technical problems are the responsibility of the civil engineering profession as a whole.

A noteworthy phase of the situation created by past conditions is that, although only large streams came under navigation control of the Federal authorities, yet the inhibitive influence of this control extended to the minor streams. And this matter is of importance because according to present indications the greater number of flood-protective and other river-regulation problems will arise on the smaller rivers and brooks. Even now there are several cases of such streams in the planning stage, besides those on which construction is progressing, while on the other hand no flood problem of a navigable river is active. However, the paralysis of civilian engineering thought with respect to river regulation has been serious, and a great deal of study lies ahead in preparing for the proper handling of the work that will need to be done. As the larger view of regulation comes more fully into being, it is likely to prove a powerful stimulus to this study.

Deep Substructure of Assay Office Built in Quicksand by Caisson-Inclosure Method

Excavation for Vault to Depth of Thirty Feet Below Groundwater Surface Carried Out Successfully Inside Caisson Cofferdam—Joints Sealed by Stockramming

By T. Kennard Thomson
Consulting Engineer, New York City

FOUNDATION conditions typical for the quicksand district of the New York financial district were encountered in very difficult work required to build a deep vault as the below-ground portion of the new Assay Office building on Wall St., New York City. The soil at the site is quicksand that will run like water; rock is about 50 ft. and groundwater about 20 ft. below street level. In this material it was required to build a substructure five stories deep below the surface—down to rock and, in fact, cutting 4 or 5 ft. into the rock—without disturbing adjoining buildings, especially the United States Subtreasury directly to the west and the 9-story Gallatin Bank to the east. The problem was handled successfully by a careful selection of working methods to suit the conditions. A caisson cofferdam was constructed, as shown completed in the view Fig. 1, and the soil inside was excavated without any trouble from leakage or pressure or movement from the ground. Prior to excavating, the joints between the several caissons of the cofferdam were sealed with clay by the stockramming process, this being the most prominent instance of the use of this process for a number of years; the results thus produced were extremely satisfactory.

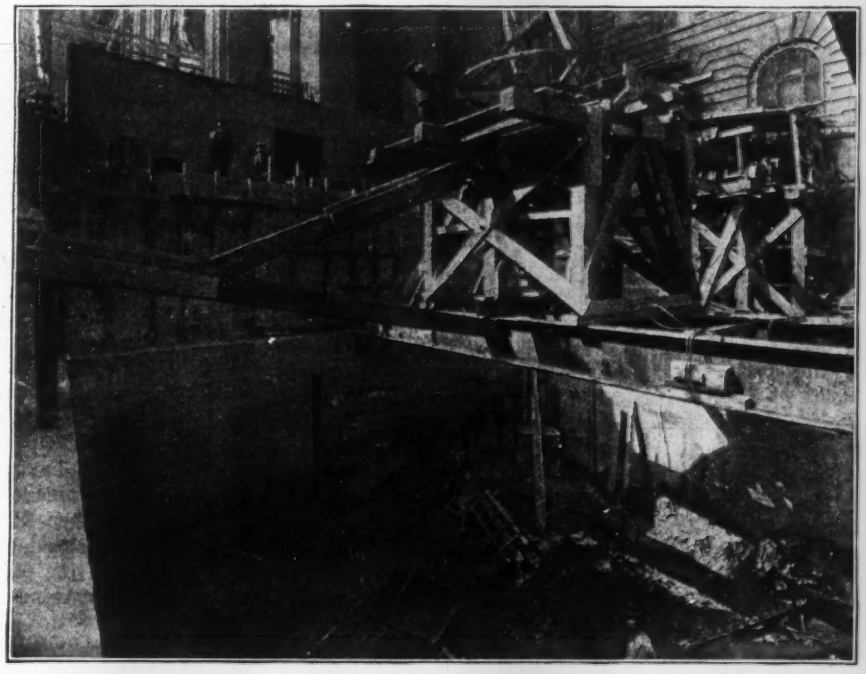


FIG. 1. COMPLETED CAISSON COFFERDAM OF NEW ASSAY BUILDING, BEING EXCAVATED WITHOUT BRACING
No leakage through joint between caisson in far wall, open below cast cap except for rammed seal of clay

An account of the work is given in the following, preceded by a statement of the foundation work for what is now the older portion of the Assay Building—namely, the refinery building—constructed 10 years ago. The caisson work of that structure differed in notable particulars from those of the more recent operation.

Refinery Building Caisson Foundations

In 1909 the United States Treasury Department let a contract to the Merrill-Ruckgaber Co. for building the foundations of a nine-story addition to the Assay Building in New York City, an addition subsequently called the Refinery Building, situated north of the Assay Building and in the middle of the block between Wall and Pine Sts. The contract included the underpinning of 25 and 27 Pine St., one by the Breuchaud method, with 3-ft. cylinders, and one by the Thomson collapsible-caisson method, as modified by Mr. Merrill; in the latter, caissons were used similar to those described by F. R. Eastman in *Engineering News-Record* of Aug. 21, 1919, p. 369, except that the cylinders were welded instead of being made of riveted sections, and were 4 ft. in diameter. The refinery building foundations themselves comprised 26 caissons, about 6 ft. square each, of reinforced concrete.

These caissons had all of the concrete placed on the deck before sinking started. In the group shown by Fig. 2, three caissons on the east side of the lot, the one at the left is nearly all down so that only the lock is seen, the middle one has the lock in place ready for sinking, while the third has just had the forms stripped and is ready for the lock. At this point four caissons were built up complete and were sunk to bedrock in two days each. There were 26 caissons in all, which reached rock at El. —26.3 to —31.3 ft., sidewalk elevation being +21.86; groundwater was reached at +8.85.

A Mattson lock was used in this work, with satisfactory results. The caisson concrete was built up in 5-ft. lifts, whereas in the recent work on the foundations of the main Assay Building the concrete from cutting-edge to ground line was all placed in one day. The solidity and imperviousness obtained by the latter method was not so essential in the earlier work, where the caissons were to support the building only and not act as cofferdam and retaining wall. The 1909 work

was completed successfully, thanks to the exceedingly great care used by the contractor, without underpinning the corners of the adjoining Gallatin Bank or the old Subtreasury Building. An example of the care taken was the late Mr. Merrill's decision to use a pneumatic caisson for sinking an elevator pit, although the depth was only 6 ft. below the surface of the water. In the local circumstances, this was probably the most economical as well as the latest method, since the quicksand at the site runs very freely indeed. Mr. Merrill probably established the record for least depth of a pneumatic caisson. On account of the care used in the work, he would have been willing not to have underpinned the buildings at 25 and 27 Pine St., but the Government engineers did not care to take any chances, and therefore required him to put underpinning cylinders (3-ft. and 4-ft.) under the buildings.

FIG. 2. CAISSONS ON EACH SIDE OF REFINERY BUILDING, 1909

Construction of the refinery building was conducted under the supervision of Robert A. Greenfield (now Major), with the writer as consulting engineer.

New Assay Building

Several years after the completion of the refinery building, the historic old Assay Building on Wall St. was torn down, and bids were asked for constructing a new building. The first bids exceeded the appropriation, and it was not until the summer of 1918 that satisfactory bids were received. Acting Supervising Architect James A. Wetmore let a contract to Charles T. Wills, Inc., for a lump sum, at a time when very few contractors would even talk about a lump-sum contract, in view of the uncertainty of the money, labor, and materials market under war conditions. The bid accepted was the second lowest, the low bidder having failed to qualify.

The building has five stories above street level and five stories below, so that it involved remarkably deep excavation, which meant difficult construction. Another bidder offered to do the work by the cofferdam method, but the Supervising Architect's office wisely refused to consider it; a similar job carried out by this method with maximum depth only 10 ft. below groundwater level resulted in a lawsuit in which each side spent probably $25,000, and in which the damage claimed was four times that amount. It would have been a very risky matter to attempt to put an open cofferdam in at the Assay Building site, over 30 ft. below water level, where the quicksand runs like water. In similar ground even careful pneumatic caisson work has caused settlement of foundations over a hundred feet away, although foundations near the excavation were not affected. It might be noticed also, concerning the practicability of the method, that in constructing the Municipal Building, about a mile to the north, the contractors, before starting the caisson work, dug a sump and attempted to lower the water level by pumping, but they lowered it only 4 in. in three weeks' work, and then, naturally, gave up the attempt.

The contractor sublet the foundation work to the Underpinning & Foundation Co.; doing all the caisson work, excavation, etc., and underpinning the Subtreasury and the Gallatin Bank. Subsequently the writer was retained by the supervising architect to act as consulting engineer and inspect the work. Figs. 3 and 4 explain the general nature of the work by vertical section through the foundation and by a plan of the caissons.

Underpinning Operations

As finally carried out, the underpinning of the Subtreasury comprised six 12-in. pipes and sixteen 15-in. pipes jacked down to hardpan under the east wall. They were grouped in six clusters or piers, the one under the heavy steps on the Wall St. front consisting of two 12-in pipes and the others of four each.

A pit was excavated under the old basement walls about 5 ft. wide by 6 ft. high, to give room for driving down the pipes. The hydraulic jacks were aided by water jet at pressures up to 80 lb. per square inch. The cutting edges of the pipes actually penetrated several inches into the hardpan, until stopped on a boulder. The sand was forced out of the pipe by water jet, and the pipe was then filled with concrete by means of a bottom-dump bucket just large enough in diameter to work inside of the pipe, and about 30 in. high. After each and every pipe had been filled with concrete it was capped with horizontal and vertical I-beams, wedged in place with steel wedges, and tested by means of a hydraulic jack to either 80 or 90 tons. This test was kept on until there was no further settlement or penetration, and while the jack was still acting the wedges were driven home. The penetration under the test varied from ¼ in. to, in one case, 3⅜ in. After the whole pier or cluster had been so treated, the rest of the space which had been cut out of the wall was filled with concrete.

Cluster 1, of two 12-in. pipes, was under the Wall St. steps, and it was not considered safe to put more than 38 tons pressure on; these pipes were stopped under that pressure at elevations —15.47 and —18.1. All other pipes were stopped on a boulder, the hardest kind of stone found in New York.

Similar methods were used under the west wall of the Gallatin Bank, where seven clusters of four and one cluster of three 15-in. pipes were put down. All the underpinning was completed during the last three months of 1918. There has been absolutely no settlement in any of the adjoining buildings or in the street surface.

The Assay Building contract called for a ring formed of 10 caissons, each 5½ ft. wide, to form the walls of

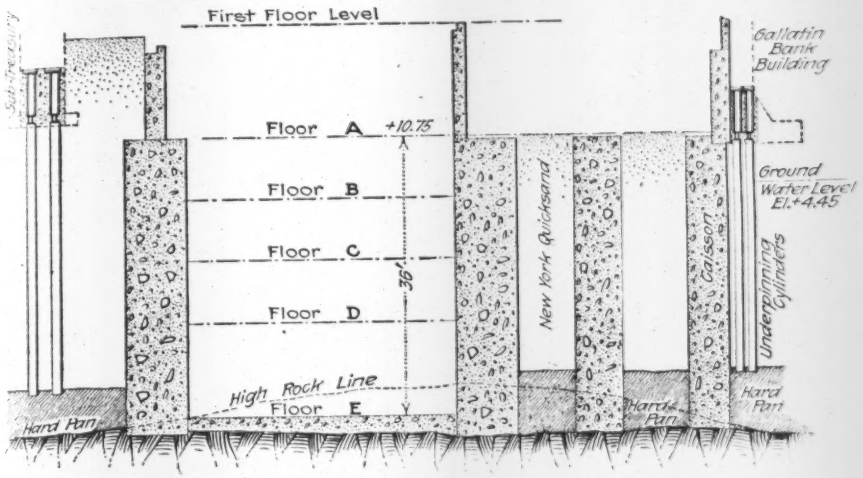


FIG. 3. VERTICAL SECTION OF NEW ASSAY BUILDING FOUNDATION, WEST TO EAST

the vault, an inclosure 38 ft. x 43 ft. (north and south). As the bottom of the excavation was to be 35 ft. below groundwater, the 5½-ft. wall would not be safe without heavy timber bracing while the cellar was being dug. It was therefore decided to increase the north, east, and west caissons to a width of 8 ft., which made timber bracing unnecessary. Two heavy struts were put in a place as a precaution, each consisting of four 12 x 12 timbers connected by blanks so as to form a strut about 4 ft. square, one north and south, the other east and west. As the wedges were loose when the struts were removed, the wedges at their ends were loose, showing that they were not needed. It should be stated here, though, that the concrete in the working chamber extended below the cutting-edge through the hardpan to bedrock, thereby giving the caissons a good anchorage; and, to make doubly sure, we connected all of the caissons together by means of a concrete cap 3 ft. thick and as wide as the caisson.

When the caisson width was increased to 8 ft., the number of caissons was decreased from 10 to 8, thereby saving two joints between caissons. All eight of the caissons were built in place before any sinking started. The concrete from cutting edge to water line, about 26 ft. high, was poured in one operation, which generally took a day and part of the night; the joint of milk of lime formed between two days' work is apt to be gradually washed out, allowing seepage to find its way through sooner or later.

The two 5½-ft. caissons, (south) took four days to sink, while the 8-ft. caissons, which were longer than the narrow ones, only took three days each, with the same number of sandhogs in each (generally four). The caissons were first ditched from 5 to 10 ft., and then the air pressure work commenced. In one case an attempt was made to sink two adjoining caissons at the same time, but this mistake was not repeated.

The concrete, of 1:2:4 mixture, had a waterproofing compound consisting of 3 lb. of integral waterproofing to each 100 lb. of cement.

The joints between these caissons were made as follows: Two 6 x 8-in. timbers were attached about three feet apart to the ends of the caisson to be sunk first, so that the next caisson could not get within 6 in. of it. These timbers extend from the cutting-edge to the groundwater surface (top of caisson). After all the caissons forming the vaults were completed from bedrock to the ground level, a 4-in. steel pipe was jetted down between the caissons in the space between the timber separators to the cutting-edge. After the sand was washed out of the pipe, clay rolled into shapes somewhat bigger than an ear of corn was rammed into the pipe, several lumps were dropped down the pipe, and a steel rod just large enough to work easily inside of the pipe was used as a ramrod to force the clay out at the bottom, gentle blows from a piledriver assisting the process.

The pipe was raised, in successive stages, as the ramming progressed so that finally the clay seal was completed to the top. The amount of clay used was approximately one-half the volume of the space between the caissons and the separators—that is, half of a space 6 in. by 3 ft. by the depth from top of caisson to cutting edge.

While it is very essential to have the clay compacted, hard enough to hold the water pressure back while the cellar is being excavated, utmost care must be exercised, on the other hand, to see that the ramming is not overdone. It has been found this "stockramming," as it is called, has an accumulative action and is powerful enough to separate the caissons. Stockramming through a single 10-in. pipe for the Croton Acqueduct cracked and lifted 500 cu.yd. of masonry.

This clay in the joints successfully held back a head of 35 ft. of water while the cellar was being excavated, and permitted the removal of the sand from between

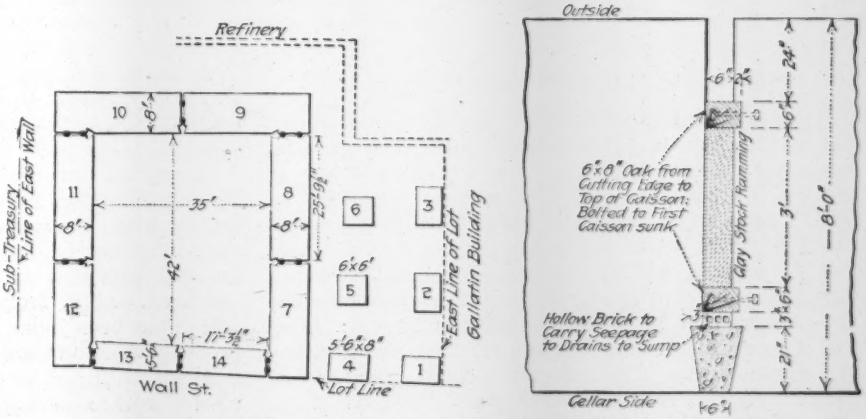
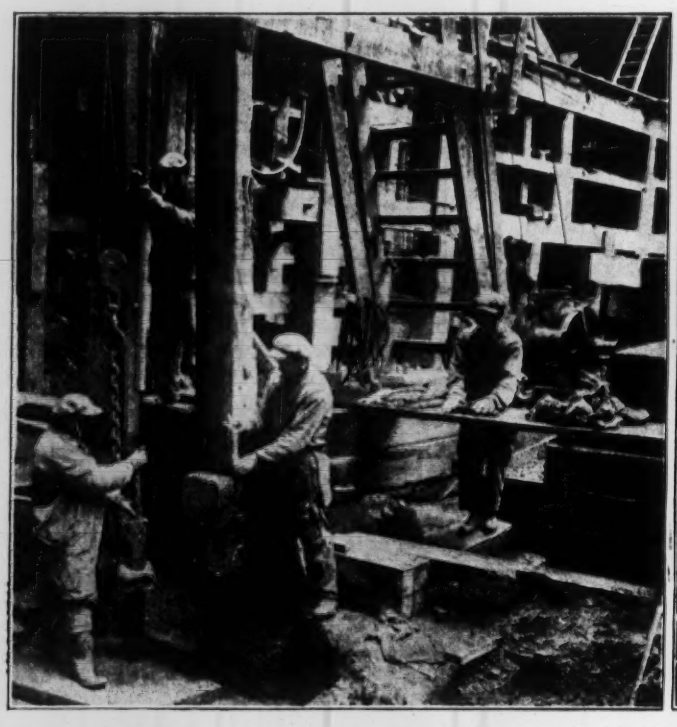


FIG. 4. PLAN OF CAISSON FOUNDATION AND JOINT DETAIL



FIGS. 5 AND 6. STOCKRAMMING TO SEAL JOINTS BETWEEN CAISSONS

the two caissons back to the first timber separator. The space so cleared was then filled with concrete. By referring to the plan, it will be seen how the writer devised a wedge shape for this concrete. This kind of a joint is not only the cheapest but much the safest that has yet been used. The joints made in halfmoon shape (double) with the aid of compressed air, lose much more material, and in one case caused the death of one man, by burning, and the severe injury of several others, owing to a candle setting fire to the rope which was lowering some oakum to be used for stopping leaks.

The thickness of hardpan passed through by the caissons was from 3 to 8 ft., and in addition from 2 to 5 ft. of solid rock was removed to get greater depth for the cellar. Rock surface as found ranged from El. —24.5 to —30.1 ft. Wherever possible to avoid doing so, the writer thinks such rock should not be removed, as the blasting makes it impossible to stop a certain amount of flow through the fissures in the rock. In many cases it would be cheaper and better to have a wider and shallower sub-basement.

Filling the Caisson Working-Chambers

When a caisson had reached rock, its working chamber was filled by the following procedure: The concrete, mixed very wet, was dumped from the concrete lock at the top of the shaft until the chamber was filled to within 30 in. of the bottom of the shaft. This concrete was allowed to set under pressure for over 24 hours; the air pressure had of course been reduced for each foot above the cutting edge (a failure so to reduce the air pressure once resulted in a serious blowout). After the concrete in the chamber had set 24 hours or more, the pressure was taken off, the airlock removed, and exceedingly wet concrete was dumped down the shaft. At each end of the caisson a vent pipe had been provided from the deck of the chamber to the top, to prevent any air being trapped under the deck, and in each case the grout was forced up these vent pipes to a distance of 12 to 20 ft. above the deck, good evidence that the air chamber had been properly filled. The writer has been using this method of filling the working chamber for over ten years, and thinks it much more reliable as well as much cheaper than the older methods.

In addition to the eight caissons forming the sides of the sub-basement (four floors below water level and five floors below street level), six caissons ranging from 5 ft. square to 5½ x 8 ft. were sunk in the space between the sub-basement and the Gallatin Bank, to carry the columns for that portion of the building. Two hundred tons of cast-iron blocks were used in sinking them, to overcome the friction of the quicksand on the caisson.

In the caisson work three shifts of men were worked eight hours each, with three to four men in the working chamber. While sometimes a gang would be taken out of one caisson to ditch or level up another caisson, there was practically only one gang working at a time. They made very good time, getting a caisson down in two to four days. In fact the sandhogs seem to be the only laborers that have maintained their old record for speed.

It may be remarked that groundwater level was at El. +4.45 in 1918, whereas it was +8.85 on the adjoining lot when the foundations for the refinery building were put down in 1909. In nearly all cases, until very recently, groundwater level has been found above high-tide level, usually from 4 to 9 ft. But recently, on one job, it has been found to be 2 ft. below high-tide level, probably due to recent excavations.

About 2 ft. of concrete was laid directly on the blasted rock, stopping a few small leaks but not the larger ones. On top of this, 16-oz. sheet-copper pans

were laid under the column bases. The column bases were then set, and in the space between the walls and the columns terra cotta blocks were placed to carry any seepage to the sump. Tar and felt was then spread between the walls and the sheet copper, which it overlapped, and finally the whole was covered with 2 ft. of good concrete.

James A. Wetmore, supervising architect of the Treasury Department, had general direction of the work; B. A. Appleyard represented him as superintendent in charge of the construction of the Assay Building. Charles T. Wills, Inc., the general contractors for the whole building, had the foundation work carried out by the Underpinning & Foundation Co. as subcontractors. The writer acted as consulting and supervising engineer for the supervising architect.

First Convention of Public Works Department Association

Delegates Meet To Consider Progress and Prospects of Plan To Co-ordinate Government Engineering Activities

NINETY-FIVE delegates from engineering and allied societies met in Washington Jan. 13 and 14 at the first convention of the National Public Works Department Association, which has developed from the conference held in Chicago April 19, 1919. The Chicago conference was called by Engineering Council to consider the desirability of organizing the engineers of the country to promote the formation of a Federal Department of Public Works under which would be gathered all of the engineering activities of the Government. So favorable were the responses from the representatives of the seventy odd societies that there was organized the Engineers', Architects' and Constructors' Conference on National Public Works with headquarters in Washington, under M. O. Leighton as chairman and C. T. Chenery as secretary. This organization, with its name changed to the National Public Works Department Association, has been functioning now for something over six months. The recent meeting was called to report progress and consider prospects.

Four sessions were held; reports of the officers and committees were heard, discussions of the Public Works Department bill now before Congress were held, addresses by Governor Lowden of Illinois, Representative Reavis, the author of the bill, and General Marshall of the Construction Division of the Army, were listened to and prospective action considered. One morning was devoted to visits by state delegations to Congressmen and in the evening of the first day a smoker was tendered by the Washington Society of Engineers. The main result of the meeting was that the delegates learned first-hand of the activities in the various states and in the home office, sensed, from their contact with Congressmen, the difficulties of the campaign and were impressed with what is probably the critical factor at the present time, the immediate necessity for more funds. In consequence they all went home with a better perspective of the movement and with some definite ideas as to how to put it across.

As projected at Chicago the Association was to be made up of technical men alone. From the headquarters at Washington, state organizations were built up from the various technical societies and functioned independently, under advice and information furnished from Washington. According to reports presented at the meeting, these state bodies have devoted themselves mainly to organization, though in a few states propaganda methods, reminiscent of the war-time "drives," have been meeting with more than indifferent success. So far, however, most of the local efforts have been toward publicity, with the idea that so complete a reformation of governmental methods as is embodied in the Public Works Department must have public support, which can be gained only through a public appreciation of the benefits to be derived. As the movement grew, its backers became convinced that it should have the co-operation of more than the technical professions which recognized its need. Accordingly, only recently, attempt has been made to enlist the aid of business men who would be benefited by a more efficient operation of the Government. This idea was well expressed by Chairman Leighton in the following paragraphs of his opening address:

> We here assembled are asking Congress to do the obvious thing. Give the Government a business-like organization. Co-ordinate the functions so that the processes of Government business shall dove-tail. Cut out the wastes and the duplications. Abolish the rivalry between departments. We advocate a Department of Public Works not merely to secure technical symmetry in our Federal organization, desirable as that end may be. Our advocacy is, in its essential features, an attempt to close some of the open ports which every ship has.
>
> When this organization was set up at Chicago I think that none of us—certainly not the speaker—had an adequate idea of the scope of the movement. We saw a loose and inefficient public works organization, divided and sub-divided into many different provinces. As technical men we know how organically wrong that was. Of the wastes and inefficiencies we were well aware. With the necessity for a co-ordinated structure, by virtue of which the technical and semi-technical fields of the Government could be rendered efficient and business-like we were profoundly impressed. But that our effort, our idea, our legislative bill would become the cornerstone of a structure embodying efficiency in all departments of Government, we could hardly foresee. As an organization our effort is still focused on a Department of Public Works and that alone. But we realize that with that principle established—that example set—reform in other provinces of Government business activity will occur by the mere logic of events. We are pioneers.
>
> This is the reason why our project for a Department of Public Works strikes straight home to the business man, the manufacturer, the contractor and the merchant, all of whom are represented here today. The technical men who met at Chicago last April to set up this organization built better than they knew. While the project retains all the virtues that appealed to us when it was launched—of technical excellence, of rational Government organization, of economy and efficiency, we now see that it reaches to national and to business prosperity, to the fiscal welfare of the nation, to the individual welfare of the productive business.
>
> We may as well recognize and admit the fact that individual initiative in America will not continue to be that spontaneous thing that it has been in the past if the rewards are to be divided and a part of them are to be wasted in the support of a chaotic Government business organization. The burdens of every business organization in the country are magnified by Government business inefficiency. We want no good and proper thing to be withheld from our Government nor in turn by our Government.

Following this idea, there were represented at the convention a number of manufacturers' and business bodies. It cannot be said that they contributed much to the discussions, except for some specific criticisms of the proposed bill, which will be mentioned later. They did, however, indicate in the purposes of the Association a lively interest that gave promise of future support, which will doubtless be sought by the executive committee.

Outside of the reports from the delegates, the main subjects of discussion were future organization, the text of the proposed bill, and finances. Each is under the jurisdiction of a special committee and on each some definite action was taken.

The Jones-Reavis bill (Sen. 2232; H. R. 6649) proposing the inclusion in the Department of the Interior, which is to be renamed the Department of Public Works, of practically all of the engineering activities of the Government and the assignment to other departments of the non-engineering bureaus of the Interior Department, has been introduced in both houses and referred to committees. It apparently has

not been seriously considered by either of the committees nor was there a definite prospect of hearings on it. One of the results of the convention—and particularly of the calls made by delegates on Congressmen—will probably be the resurrection of the bill from committee and early consideration through hearings. Up to now, the Public Works Department Association has included in its literature the statement that it urged the passage of this bill. The convention brought out the fact that the Association does this with reservations.

These reservations were brought about by criticisms, mainly by non-engineering interests, of the disposition of the various non-engineering bureaus which have to be transferred out of the Department of the Interior. Particular criticism was leveled at the assignment of the Bureau of Education to the Department of Labor. In order to meet these criticisms the convention adopted, unanimously, a resolution stating that the Association is not particularly concerned with the disposition of the non-technical bureaus, feeling that the main purpose to be achieved—that is, the co-ordination of engineering activities—is the important feature of the movement and that the assignment of non-technical activities can be taken care of as Congress sees fit, without diminishing the effectiveness of the proposed department. Aside from this, the discussion on the bill was negligible. No comment to speak of was made on the make-up of the new department as provided for in the bill and the convention approved the statement of the committee that at present it was inadvisable to make any changes in the text of the bill.

New organization and finances are interwoven. So far the Association has been largely financed by Engineering Council, which has advanced $18,000, and by contributions from state organizations of something over $6,000. Of this there is left about $5,000, or about enough to finance the Washington office six weeks. The budget calls for an expenditure by headquarters of $3,500 a month, and suggests an expenditure by the state organizations for the next six months of $4,800 per month. The delegates agreed that the latter sum should be raised by the respective states for their own use, which leaves an annual budget of $42,000 plus the reimbursement to Engineering Council of its $18,000, or a total of $60,000 to be raised for a year's work. This sum has been apportioned to the various states in proportion to population, and the delegates went home promising that each state's quota should be raised, the details to be left to the respective states.

This apportioning, however, is not new. Last year an apportionment to the states on a similar basis was made, with a total of $100,000 in view. From this apportionment, the $6,300 from the various state organizations was received. It, therefore, became evident early in the convention that this question of finances was critical. Unless some method of raising funds more successfully could be devised, the movement must die. Largely with this in mind, probably, the committee on new organization brought in a report which proposed a system of individual memberships at $5 a year, with graduated higher memberships, patrons, etc., at higher amounts. While containing clauses which might be construed as recommendations for the continuance of the present rather loose form of representative organization, this report immediately impressed the delegates as a radical revision of the association which was not only unwise but unworkable. The criticisms were so forcible, that the report was returned and a new one brought in in which the direct representation and membership idea was discarded, but great emphasis laid on the need for more funds. Both reports contained recommendations for the enlargement of the Association to include "business, professional and social bodies." The rejected report, moreover, contained recommendations for the budget system in the Federal Government and for a general reorganization of governmental activities looking toward efficiency. These clauses, after criticisms from the floor, were omitted from the adopted report.

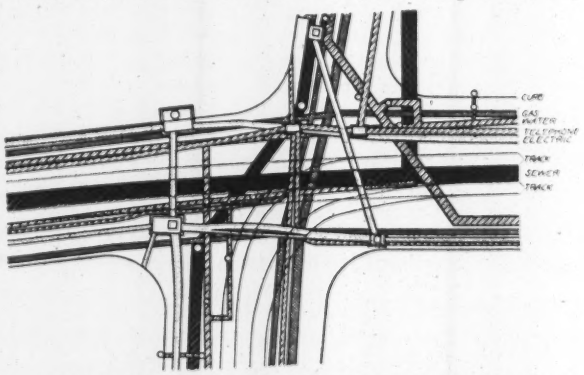
The result of the action on the committee reports is that the Association is to continue along the same lines as it has during the past few months, except that an effort is to be made to give the movement a wider appeal, so that the accusation that it is being fostered by engineers for their material benefit may be withdrawn by those who have made it, either publicly or in their own minds. At the same time it is realized that the promotion of such an idea costs money, and the delegates undoubtedly realize that they must return to their respective societies with the intention of concentrating on the raising of sufficient funds to keep the movement active during the next six months, the most critical in its existence.

The officers of the Association were continued in service, with the addition of several executive committee members drawn from the industrial field.

Underground Structures Laid Haphazard

WHAT happens when pipes and wires are placed underground without any control as to systematic location by the municipality concerned is shown by the accompanying illustration from the latest annual report of the Department of Engineering of Hartford, Conn. Mr. Clark, city engineer, states in his report as follows:

"With but one exception, all the underground construction shown in this cut was installed prior to any attempt on the city's part to regulate or exercise any appreciable control over sub-surface work. The resultant random positions of structures in this intersection, and there are many others in the same condition, make it extremely difficult to assign locations for new work. If all these structures had been assigned locations according to present methods a great deal more space would be available for enlargements and for a probable high-pressure water system for fire protection, or any other future installation."



HAPHAZARD ARRANGEMENT OF UNDERGROUND STRUCTURES, HARTFORD, CONN.

Operating Results of Dyckman Street Sewage-Screening Plant

Scanty Data on Riensch-Wurl Screens Added to by Working Tests in New York City—Other Results Compared

By Charles E. Gregory
Formerly Chief Engineer of Sewers, Borough of Manhattan, New York City

VERY few reliable data showing the normal operating efficiency of fine screens in this country are available. A recent test of the Riensch-Wurl screening plant at the foot of Dyckman St., Borough of Manhattan, New York City, furnishes some much needed information on this subject.

The plant consists of two 14-ft. disk screens, and the present flow averages a little less than 2,000,000 gal. a day. The sewage reaches the plant in less than 20 min. from its most remote source and is not badly broken up. A description of the plant was published in *Engineering News-Record* of Apr. 3, 1919, p. 672.

The test here reported was conducted jointly under the supervision of Kenneth Allen, sanitary engineer of the Board of Estimate and Apportionment, and the

TABLE I. TESTS OF RIENSCH-WURL SCREENS, DYCKMAN STREET PLANT, BOROUGH OF MANHATTAN, NEW YORK CITY

		June 9		June 9-10		June 10	
		10:15 a.m. to 2:15 p.m. (Shower 12-12:30)	2:15 p.m. to 6:15 p.m. (Light shower at 2:45)	6:15 p.m. to 10:15 p.m.	10:15 p.m. to 2:15 a.m.	2:15 a.m. to 6:15 a.m.	6:15 a.m. to 10:15 a.m.
Sewage Flow:							
Volume	gal.	384,600	269,300	285,600	230,200	166,100	350,900
Rate	m.g.d.	2.308	1.616	1.714	1.381	0.997	2.105
Analytical Results:							
Raw Sewage:							
Suspended solids	p.p.m.	276	84	86	53	40	168
Volatile	p.p.m.	179	76	79	50	34	142
Ash	p.p.m.	97	8	7	3	6	26
Settleable solids	p.p.m.	226	41	56	53	40	106
Volatile	p.p.m.	143	33	49	50	34	92
Ash	p.p.m.	83	8	7	3	6	14
Screened Sewage:							
Suspended solids	p.p.m.	233	60	60	34	3	110
Volatile	p.p.m.	146	55	55	34	3	90
Ash	p.p.m.	87	5	5	0	0	20
Settleable solids	p.p.m.	183	17	30	34	3	48
Volatile	p.p.m.	110	12	25	34	3	40
Ash	p.p.m.	73	5	5	0	0	8
Screenings:							
Removed by ¼-in. screen	p.p.m.	43	24	26	19	3.7	58
Moisture	%	78.7	75.9	79.4	76.1	79.8	78.4
Dry material	%	21.3	24.1	20.6	23.9	20.2	21.6
Ash (dry basis)	%	22.2	13.5	6.6	16.5	15.2	9.7
Volume	cu.ft.	11.16	4.52	5.28	3.11	0.66	13.59
Volume per m.g.	cu.ft.	29.02	16.8	18.4	13.5	4.0	38.7
Weight	lb.	644	226	303½	152	25	781½
Weight per m.g.	lb.	1,675	839	1,063	660	151	2,227
Weight per cu.ft.	lb.	57.7	50.0	57.4	48.9	37.9	57.5
Power consumed	k.w.h.	36	28	26	27	29	27
Power consumed per m.g.	k.w.h.	94	104	91	117	175	77
Head lost—average	ft.	0.25	0.16	0.12	0.08	0.07	0.29
Removal of suspended matter	%	15.6	29.0	30.6	35.8	9.25	34.6
Removal of settleable solids	%	19.0	58.9	46.8	35.8	9.25	54.8

		June 18		June 18-19		June 19	
		10:00 a.m. to 2:00 p.m.	2:00 p.m. to 6:00 p.m.	6:00 p.m. to 10:00 p.m.	10:00 p.m. to 2:00 a.m.	2:00 a.m. to 6:00 a.m.	6:00 a.m. to 10:00 a.m.
Sewage Flow:							
Volume	gal.	326,400	268,300	273,100	230,100	156,700	299,900
Rate	m.g.d.	1.958	1.610	1.639	1.380	0.940	1.799
Analytical results:							
Raw Sewage:							
Suspended solids	p.p.m.	139	113	122	73	28	197
Volatile	p.p.m.	91	76	91	56	28	147
Ash	p.p.m.	48	37	31	17	0	50
Settleable solids	p.p.m.	62	69	92	73	28	119
Volatile	p.p.m.	21	46	76	56	28	80
Ash	p.p.m.	41	23	16	17	0	39
Screened sewage:							
Suspended solids	p.p.m.	118	100	100	60	24	160
Volatile	p.p.m.	72	64	70	44	24	114
Ash	p.p.m.	46	36	30	16	0	46
Settleable solids	p.p.m.	41	56	70	60	24	82
Volatile	p.p.m.	2	34	55	44	24	47
Ash	p.p.m.	39	22	15	16	0	35
Screenings:							
Removed by ¼-in. screen	p.p.m.	21	13	22	13	4	37
Moisture	%	79.7	81.0	79.5	82.4	84.3	84.4
Dry material	%	20.3	19.0	20.5	17.6	15.7	15.6
Ash (dry basis)	%	10.1	8.1	6.7	7.7	11.2	10.2
Volume	cu.ft.	5.18	2.76	4.55	2.89	0.66	9.84
Volume per m.g.	cu.ft.	15.9	10.3	16.7	12.6	4.21	32.8
Weight	lb.	283	148	244	137	36	593
Weight per m.g.	lb.	868	552	893	595	230	1,977
Weight per cu.ft.	lb.	54.6	53.6	53.6	47.4	54.5	60.3
Power consumed	k.w.h.	32	36	31	32	28	28
Power consumed per m.g.	k.w.h.	98	135	114	139	178	93
Head lost—average	ft.	0.018	0.012	0.027	0.015	0.041	0.031
Removal of suspended matter	%	15.1	11.5	18.0	17.8	14.3	18.8
Removal of settleable solids	%	33.9	18.8	23.9	17.8	14.3	31.1

SUMMARY OF RESULTS OF 24-HOUR TESTS

	Screen No. 1	Screen No. 2		Screen No. 1	Screen No. 2
Width of slot	¼ in.	¼ in.	Screenings:		
Speed	0.5 r.p.m.	0.426 r.p.m.	Moisture	78.5%	81.7%
Day of week	Mon.-Tues.	Wed.-Thurs.	Dry material	21.4%	18.3%
Flow	1,687,700 gal.	1,554,500 gal.	Ash (dry basis)	14.1%	9.1%
Raw sewage:			Volatile matter	85.9%	91.9%
Suspended matter	137 p.p.m.	122 p.p.m.	Volume	38.32 cu.ft.	25.88 cu.ft.
Settleable solids	100 p.p.m.	78 p.p.m.	Volume per m.g.	22.7 cu.ft.	16.65 cu.ft.
Screened sewage:			Weight	2,132 lb.	1,443 lb.
Suspended matter	101 p.p.m.	102 p.p.m.	Weight per m.g.	1,264 lb.	928 lb.
Settleable solids	64 p.p.m.	58 p.p.m.	Weight per cu.ft.	55.6 lb.	55.8 lb.
Removed by screen:			Removal of suspended matter	26.3%	16.6%
Suspended matter	36 p.p.m.	20 p.p.m.	Removal of settleable solids	36.0%	19.4%
Settleable solids	36 p.p.m.	20 p.p.m.			

TABLE II. COMPARATIVE RESULTS OF TESTS OF VARIOUS RIENSCH-WURL SCREENS

Location	Diameter, Ft.	Slot, In.	Flow, 1,000,000 Gal. D.	Screenings per 1,000,000 Gal. Cu.Ft.	Screenings per 1,000,000 Gal. Lb.	Dry Material per 1,000,000 Gal., Lb.	Per Cent. Removal Suspended Matter	Per Cent. Removal Settleable Solids	Remarks
Dresden, Germany	26.2	0.08	26	26.2	5,970	955	31.0	....	84% moisture in screenings
Mainz, Germany	14.8	0.08	3.3–17.4	....	790	...	36.0	42.0	Experimental
Daytona, Fla.	8.0	1/4	0.4–0.5	18.8	1,080	....	....	....	Day sewage
Long Beach, Calif.	14.0	1/4	2.6	27.0	1,810	235	16.2	....	87% moisture in screenings
Manhattan, N. Y.	14.0	1/2	1.74	22.7	1,264	270	26.3	36.0	80% moisture in screenings
Plainfield, N. J.	14.0	1/4	1.74	16.65	928	170	16.4	19.6	
	10.0	1/4	3.53	16.3	1,510	...	....	....	

author. The chemical determinations were made by W. T. Carpenter. The period of the test covered two entire days, and three 4-hour periods on other days.

The flow of sewage was continuously measured by a sharp-edged weir 2 ft. long placed in the outlet gate below the screen so as not to interfere, by ponding, with the sewage as it approached the screen. The record of depths on the weir was made by a Freize register adjusted to record directly the actual depths.

Samples were taken from the effluent below the screen at 15-min. intervals and combined every four hours into a composite sample. The screenings for each corresponding period were measured for volume in cylindrical metal cans, were weighed and then dumped on a concrete floor, and quartered down for a composite sample for analysis. As the screenings are brushed off from the disk they are caught in a metal can with perforated bottom, so that any surplus moisture may readily drain away.

Conditions were normal, as far as could be judged in advance. There were light showers June 9, but they did not appreciably increase the flow in the sewer and probably had no influence on the result. The screenings removed June 9 were somewhat less than on many previous days, but the flow may have been less or the sewage weaker.

The strength of the raw sewage was found by adding the screenings removed to the suspended solids found for each corresponding four-hour sample. This method eliminates errors of sampling and removes doubt as to whether the effluent is the identical sewage which was sampled before treatment.

Table I gives the results in detail and closely confirms the 32% removal found in the less careful tests made when the plant was first put in operation; the results were published in *Engineering News-Record* of Apr. 3, 1919. At that time the flow was greater, the volume and weight of screenings were greater, but the percentage of moisture found in the screenings was from 5 to 10% less. This moisture content alone would account for the difference in the final result.

As before, the 3/4-in. by 2-in. slot removed about 50% more materials than the 1/16-in. by 2-in. opening. Attention is directed to the small loss of head through the screen, especially on the one with 1/16-in. openings.

The normal estimated capacity of each 14-ft. screen is 5,000,000 gal. per day. The current flow of 2,000,000 gal. or less covers only a sector below the crown of the hat-shaped disk, and consequently there is a smaller proportion of partially obstructed openings than when more of the disk is submerged. The greater depths and greater velocity through the openings when the screen is running at full capacity cause a greater loss of head, although it has seldom reached six inches.

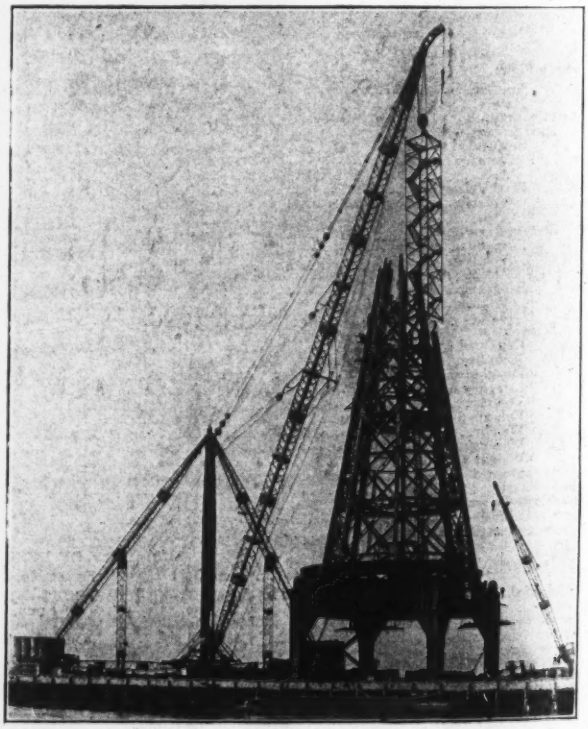
The wide variations in the strength and flow of sewage and screenings removed throughout the day, as well as from day to day, indicate that only a long series of tests can firmly establish the average efficiency of the device, but the fact, really more important, that it does not remove from each 1,000,000 gal. of sewage from 1200 to 1500 lb. of sludge is well established by the daily records of the maintenance department.

There is also appended for comparison a table of results at other places (Table II).

Largest Derrick Built to Erect Great Hammerhead Crane

Handles 40 Tons at 125-Ft. Reach of 252-Ft. Boom In Building 350-Ton Fitting-Out Crane At Philadelphia Navy Yard

TO erect the enormous 350-ton fitting-out crane at the Philadelphia Navy Yard, the McMyler Interstate Co. of Cleveland, Ohio, has designed and built a steel stiff-leg derrick of unprecendented size, capable of carrying 40 tons with a 125-ft. reach and a 252-ft. boom. With the addition of the 13-ft. goose-neck on the end of the boom and the 10-ft. lift of the base of the mast, this rig can handle 5 tons at a height of 270 ft. above the pier deck on which it rests. The derrick was especially built for the erection of this particular

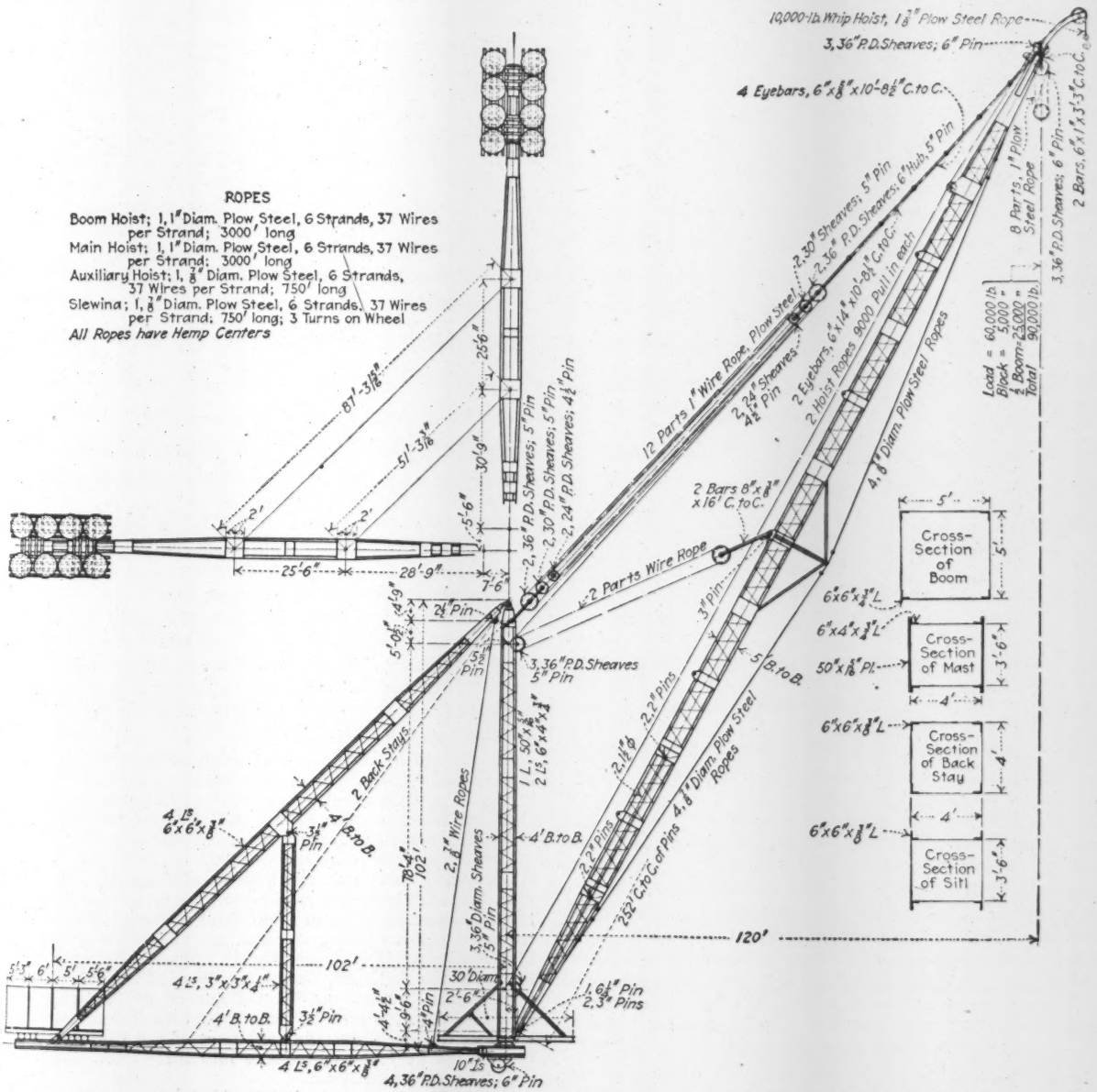


DROPPING STAIRWAY DOWN FITTING-OUT CRANE FROM END OF 252-FT. BOOM

crane, but it was designed for easy erection and demounting, so that it can be readily transported for use elsewhere.

The 350-ft. hammerhead crane is the largest capacity crane ever built. It was designed by the McMyler Interstate Co. at the general specification of the Navy Department for the new fitting-out pier at the Philadelphia Navy Yard. The detailed design of the crane is extremely interesting, but the authorities do not care to enter into it until after it has been tested. Its extreme height above the pier deck is 230 ft., and due to a special effort to increase ship fabrication and reduce erection costs, there were single pieces running up to 40 tons in weight to be erected in place.

This whole structure is near the end of a comparatively narrow pier on which practically all of the material in erection was brought by truck or train, although it was possible to bring some in by barge beside the pier. In the erection one derrick described here was utilized for placing practically all material, although a locomotive crane running out on the track of the pier was also available. The view showing the latest stage of completion herewith was taken in September, the work of erection having started last spring.


ROPES
Boom Hoist; 1, 1" Diam. Plow Steel, 6 Strands, 37 Wires per Strand; 3000' long
Main Hoist; 1, 1" Diam. Plow Steel, 6 Strands, 37 Wires per Strand; 3000' long
Auxiliary Hoist; 1, 7/8" Diam. Plow Steel, 6 Strands, 37 Wires per Strand; 750' long
Slewing; 1, 7/8" Diam. Plow Steel, 6 Strands, 37 Wires per Strand; 750' long; 3 Turns on Wheel
All Ropes have Hemp Centers
10,000-lb Whip Hoist, 1 3/8" Plow Steel Rope
3, 36" P.D. Sheaves; 6" Pin
4 Eyebars, 6" x 7/8" x 10'-8 1/2" C. to C.
2, 30" Sheaves; 5" Pin
2, 36" P.D. Sheaves; 6" Hub, 5" Pin
8 Parts, 1" Plow Steel Rope
3, 36" P.D. Sheaves; 6" Pin
2 Bars, 6" x 1" x 3'-3" C. to C.
Load = 60,000 lb
Block = 5,000 "
1/4 Boom = 25,000 "
Total 90,000 lb
12 Parts 1" Wire Rope, Plow Steel
2, 24" Sheaves; 4 1/2" Pin
2 Eyebars, 6" x 1 1/4" x 10'-8 1/2" C. to C.
2 Hoist Ropes 9000 Pull in each
4, 1 3/8" Diam. Plow Steel Ropes
87'-3 15/16"
51'-3 3/16"
30'9"
25'6"
5'-6"
2'
2'
25'-6"
28'-9"
7'-6"
2, 36" P.D. Sheaves; 5" Pin
2, 30" P.D. Sheaves; 5" Pin
2, 24" P.D. Sheaves; 4 1/2" Pin
2 Bars 8" x 7/8" x 16' C. to C.
2 Parts Wire Rope
3" Pin
2 1/2" Pins
5' B. to B.
2 1/2" Pins
2 1/2" Pins
2.52' C. to C. of Pins
4, 1 3/8" Diam. Plow Steel Ropes
120'
Cross-Section of Boom
5'
5'
6" x 6" x 1/2" L
6" x 4" x 3/8" L
50" x 1/2" Pl.
Cross-Section of Mast
3'-6"
4'
6" x 6" x 7/8" L
Cross-Section of Back Stay
4'
4'
6" x 6" x 3/8" L
Cross-Section of Sill
3'-6"
2 Back Stays
4, L 6" x 6" x 3/8"
3 1/2" Pin
4' B. to B.
2, 3" Wire Ropes
3, 36" Diam. Sheaves
5" Pin
1 L, 50" x 7/8"
2 L's, 6" x 4" x 3/8"
4' B. to B.
78'-4"
102'
102'
5'-3"
6'
5'
5'-6"
4 L's, 3" x 3" x 1/4"
4' B. to B.
3 1/2" Pin
4'-4 1/2"
9'-6"
4" Pin
30' Diam.
2'-6"
1, 6 1/2" Pin
2, 3" Pins
4 L's, 6" x 6" x 3/8"
10" I's
4, 36" P.D. Sheaves; 6" Pin

DETAILS OF LARGE STIFF-LEG DERRICK USED IN ERECTING HIGH FITTING-OUT CRANE AT PHILADELPHIA NAVY YARD

The erecting derrick is of the regulation stiff-leg arrangement, and is extraordinary mainly on account of its size. As shown in the drawing the boom is 252 ft. long c. to c. of pins, and has in addition a gooseneck extending 13 ft. farther. The mast is 102 ft. high and the sill extends back 102 ft. The stiff-legs have each a vertical pin-connected brace midway of their length. All members are of latticed angle sections, varying as shown in the drawing, and all main joints are pin connected. The boom is additionally stiffened

FITTING-OUT CRANE NEARING COMPLETION

with four 1-in. plowsteel ropes trussed out from a middle post. According to the design shown, the live-load capacity is 30 tons at 120 ft., but the derrick has been used to carry 40 tons at 125 ft.

The main mast is supported on a special pin bearing bathed in oil, with the base resting on a I-beam grillage supported on blocking from the pier deck. The ends of each stiff-leg are supported on similar blocking and in the location where erected one of the stiff-legs extends out over the water and has had a special pile platform built to carry it. The counterweights at the stiff-legs have been designed especially for ease in re-erection. Each counterweight consists of eight large steel tanks erected on an I-beam grillage. These tanks are of different diameters, 5 ft., 5 ft. 3 in., 5 ft. 6 in., and 6 ft., so that, with two tanks of each of the four dimensions, they can be nested for easy transportation. In place as counterweights they are filled with water, giving a total loading of 75 tons for each counterweight, but for transporting they can be put one within the other and the smallest one filled with very small tools and equipment, requiring only the car space sufficient to carry four of the tanks. All other parts of the derrick are demountable so as to be packed in freight cars.

Control of the derrick is in the hands of one man, working in the engine room just alongside of the counterweights on the pier. In this engine room is a double-cylinder triple-tandem drum steam-driven hoisting engine, and two separate single-drum electric hoists. The two front drums of the steam hoist control the main fall, the third drum of the main hoist the secondary fall on the goose-neck, one of the electric drums controls the boom and the other the bull wheel. Two speeds on the main fall are available.

The topping lift is reaved through a 12-part line to the top of the boom with one two-part and one fixed line to intermediate points on the boom. The 12-part top fall feeds through two sets of three double-sheave pulleys, the upper of which are tied to the top of the boom with an eye-bar connnection.

Provision is made at the bottom of the main mast for the bottom sheave to be shifted to fit any horizontal angle of spread of the legs, so that the engine can be located anywhere between the stiff-legs that the site requires. Furthermore, extra rivet holes are punched in the grillage frame under the main mast, so that the stiff-leg sills can be moved at variable angles 14 ft. either way from the center at the end of the stiff-leg.

The whole work was under the supervision of the Corps of Civil Engineers of the United States Navy, Capt. A. L. Parsons, Public Works Officer, and Lt.-Com. O. A. Mechlin, Assistant Public Works Officer.

Relation of Engineer to Architect

—*A Discussion*

BY FRANCIS C. SHENEHON

Editor's Note: The report of Engineering Council's Committee on Licensing Engineers, which contained a model license law to regulate the practice of engineering and architecture, was published by Council Dec. 19, 1919. Appended to the published report was a letter written to T. L. Condron, chairman of the Committee on Licensing Engineers, by Francis C. Shenehon, one of the Committee's most active members. The letter was written in anticipation of the possible opposition of some engineers to the inclusion of architects in an engineering bill and is an admirable presentation of the case for a general bill covering the two professions. The text of the letter follows:

In order to review in my own mind our reasons for the inclusion of architects in our bill—and to keep these reasons active in your mind—I am discussing at some length the situation which confronted us and the avenues which our minds traversed in reaching our conclusion.

Historically, we find the builders of fortifications, the military engineer; and the builder of dwellings and temples, the architect, was earliest on the ground. The distinction was then between soldier and architect, not between engineer and architect. All of us who have translated him remember that Julius Cæsar built a bridge, and we know of the military Roman roads of England. In his illuminating lecture on "The Romance of Engineering," Professor C. J. Tilden of Yale says that Vitruvius in his treatise, written about the beginning of the Christian Era, divides the field of architecture into three main divisions:

1. The art of building.
   - (a) The construction of fortified towns and of works for general use in public places.
     - I. For defensive purposes—the planning of walls, towers and gates—permanent devices for resistance against hostile attacks.
     - II. For religious purposes—the erection of fanes and temples to the immortal gods.
     - III. For utilitarian purposes—the provision of meeting places for public use, such as harbors, markets, colonnades, baths, theaters, promenades, and all similar arrangements.
   - (b) The putting up of structures for private individuals.
2. The making of time-pieces (sundials, water clocks, etc.).
3. The construction of machinery.

(a) Civil—water wheels, screw pumps, hydrometers, etc.
(b) Military — balistæ, catapults, rams, siege machines, etc.

The very considerable Avignon bridge across the Rhone River (about 1200 A.D.), with eighteen clear arch spans from 65 to 80 ft. each, in a swift-flowing river subject to ice jambs, was regarded as a work of architecture. The term architect of bridges is authentic. Michelangelo (1475-1564) was not only the Architect of St. Peters, but he designed the fortifications of Rome.

Leonardo da Vinci (1452-1519) not only made plans for the Milan Cathedral, and painted the "Last Supper" and "Mona Lisa," but he was a chief military engineer, and a hydraulic engineer dealing with irrigation, river control and harbor works, and designed a flight of six vessel-locks. The utilization of his creative imagination in directing the forces of nature appears to have appealed to him no less strongly than in architecture, sculpture and painting. He styled himself engineer as well as architect.

"Master Builders"

The term architect in its etymology means "Master Builder." Should the determination of the field of architecture rest on a historical basis, its scope would be far wider than latter-day engineers would wish to concede. The wonder is not the present encroachment of architects upon the legitimate field of engineering, but the expanse of the fields, once interchangeable, over which engineers have gained sole dominion.

It is not material to put one's finger on the year when a distinct cleavage was visible between architecture and engineering, because the two are so closely knit now that it will require a surgical operation to separate them. It appears that in the evolution of construction two classes of builders, blood-brothers, in fact, have by some vagary of word-growth been verbally torn apart and their kinship sometimes questioned. It is odd that in this juggling of old terms and the emergence of new terms, one class of engineers — and a class whose work is of the highly specialized, technical kind which deals with the direction of great mechanical forces—has kept the old family name, the Naval Architect.

What I am endeavoring to accent is that an accident of name-evolution has tended to segregate one class of master-builders from the other classes of master-builders, and that this segregation does not grow out of any vital difference in fact. It may be thought that initiative and imagination are the qualities of architects, while engineers deal with the prose of construction. Analysis will, however, reveal the fact that 80 per cent of the architectural structures of our cities are commonplace, with no peculiar beauty or originality. Now and again a Woolworth building springs sky-ward, worthy of the phrase "frozen music," and we recognize again the master-builder of the sixteenth century. But the same quality of mind went into the wireless telegraph, the airplane, the Panama Canal and hydro-electric developments and transmission at Niagara. Engineers without creative imagination are as mediocre as architects without the same vital and indispensable attribute of the master-builder. Architects must recognize that scientific imagination is on the same high plane as their own best creative thought; and engineers must concede the aesthetic contribution of architects in adding to the durable satisfactions of life. Both are creative workers.

An architect is an engineer whose higher activities are those of an artist; and the two kinds of activity are blended in an individual man; in some cases the architect is $99\frac{44}{100}$ per cent engineer, and sometimes he is $99\frac{44}{100}$ per cent artist; and in some cases the blend is fifty-fifty. As the activities of architects reach out from the nucleus of fundamental builder into fields of art, so the activities of engineers, all centered on this same nucleus, reach into individualized fields. The mining engineer is much geologist and chemist; the sanitary engineer reaches toward the biological sciences and medicine; valuation engineers are part economists; the mechanical engineer touches industrial zones; the electrical engineer dwells on the frontiers where his particular manifestation of energy leads him; the hydraulic engineer is part magician and part meteorologist; and all are inventors.

The structural engineer must spend part of his time denying that he is an architect; but at times has been required to take out a license as an architect to continue his customary practice. The architectural engineer is the missing link.

The practice of all these various master-builders is woven together in a single fabric; it forms a single polychromatic profession. There is no more reason for excluding the architect from the fraternity of master-builders than for excluding an admiralty lawyer from his legal kin because his practice has a somewhat different complexion; or of excluding an eye, ear and throat specialist from the balance of medical men because of his particular field.

Strength in United Profession

The strength and welfare of all master-builders lie in the solidity of a single, great, united profession, not in divided counsels. The Architects' Model Law is a proclamation of secession, and menaces fields of practice not territorially belonging to architecture. The Structural Engineers' Law of Illinois was a necessary defensive measure tending further to disintegrate the profession as a whole. Why not an Electrical Engineers' Law, a Mining Engineers' Law, and others, each branch fighting for itself and by itself? In 1861, the secession of certain Southern States threatened the Union. Imagine our world power, had the theory of state sovereignty prevailed and this country been broken up into little nationalities like the Balkans! Modern organization is tending toward consolidations, not dissolutions; and the uniform law proposed for all master-builders is constructive in its large purpose to end factional divergences and to provide for influential, powerful co-operation.

Perhaps the action of the engineers in writing architects into its Uniform Bill may be construed as a little indelicate because architects were not represented on the Committee or in the Council. But the building of a preliminary bill is only one step toward the ultimate bill which may be enacted into law. The bill presented is a text upon which discussion is to be centered to the end that a final perfected bill may be evolved. With the Architects' Model Law, affecting engineers, issued as a perfected document for passage by the varius states, and the Engineers' Bill, affecting architects, still plastic, it is desirable that archiects be invited to from part of a new committee to reconcile differences, and write out a single bill.

The Architects' Model Law is not unalterably engraved in stone. A committee's recommended bill, even when underwritten by the concurrence of a large assembly voting for its adoption, is not an unchangeable finality. Men who have dealt with the conclusions of assemblies know something of the imperfection of majority votes, which a chance might have swerved into a minority vote; and men who have served on committees know something of the accidental make-up of committees, the pre-occupation of the members and the bare margin of judgment on which vital features hinge.

The Architects' Law in Illinois created bitterness, antagonism and division—internal warfare among the master-builders. The Engineers' Bill may for a time encounter opposition, but as it protects the architect and the engineer without discrimination, and works with the utmost of economy in administration for the welfare of all, it is hard to see how it can provoke honest hostility.

The Architects' Model Bill can never become law in any state where engineers are awake to the menace of its provisions, and are organized to circumvent unwholesome legislation. It carries its own death sentence when truly interpreted to a legislature. When architects fully comprehend this fact perhaps a practicable compromise bill may be agreed upon, which can be supported by all engineers and all architects, and has a chance to be enacted into law. Perhaps the smooth functioning of the Michigan Law, which includes engineers, architects and land surveyors is evidence of the desirable inclusion of a License Law.

Foundation Troubles of Portland City Grain Elevator

Settlement of Large Concrete Structure Stopped by Driving Pinch Piles To Compress Soft Ground Already Piled

CONSTRUCTION progress on the new concrete grain elevator being built for the City of Portland, Ore., was stopped last spring because of what promised to be a serious subsidence of the structure. At one corner the settlement reached 2 ft. and was progressing with the addition of load. A board of consulting engineers called in to report on the conditions and a method of curing them advised as a tentative remedy to stiffen up the already piled soft ground by driving rows of so-called pinch piles around the entire structure. This was started and proved successful in stopping the subsidence, so construction was resumed and is being carried to its conclusion simultaneously with the pinch-pile operations. At the same time an excessive load, in the way of hydraulic fill sand in the base of the elevator, was removed.

PINCH PILES FIRST DRIVEN AROUND NORTHEAST CORNER OF STORAGE ANNEX. CURTAIN WALLS NOT YET BUILT

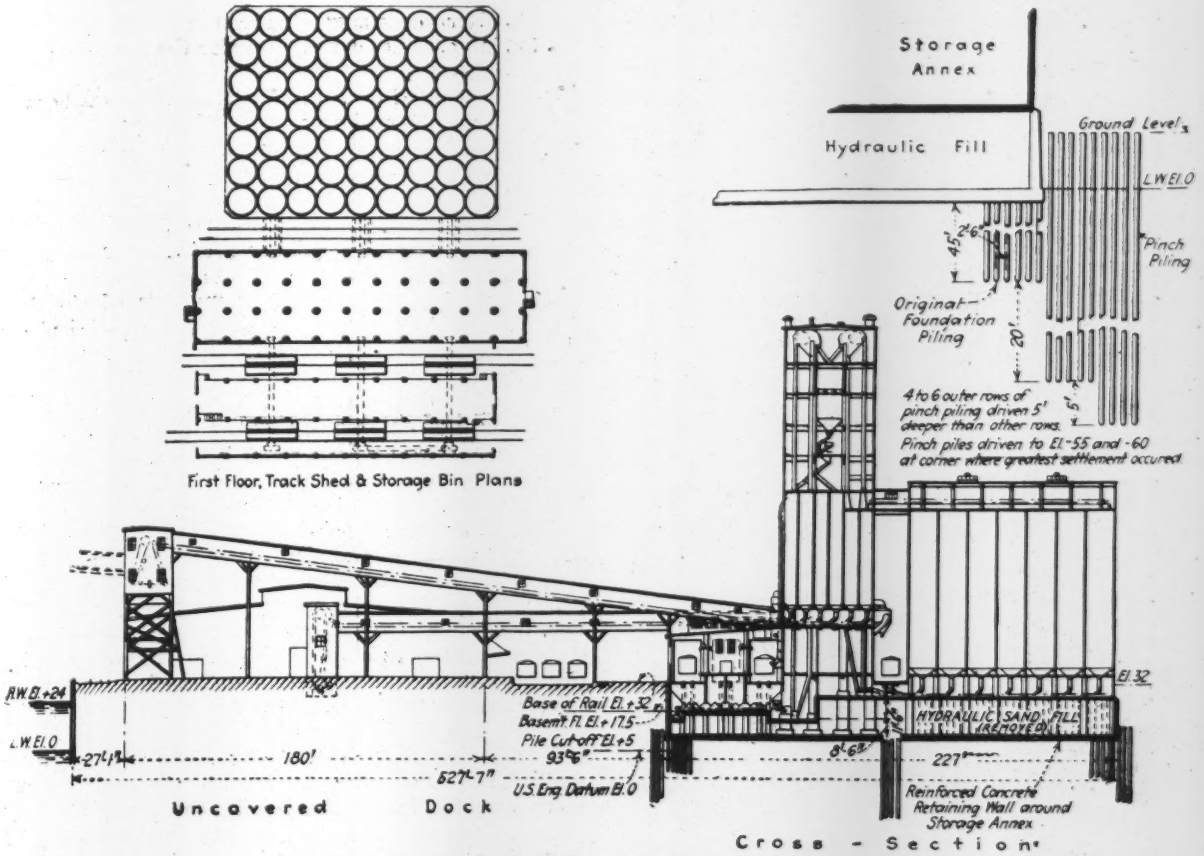
The municipal grain elevator at Portland is a part of the new St. Johns Terminal being built by the city on the east bank of the Willamette River, about seven miles north of the central part of the city. It is described in an article on p. 179 of this issue. The grain elevator consists of a track shed, an operating house, and a storage annex, built in that order back from a marginal pier, which is in effect a wharf. The elevator is of reinforced concrete, with a track shed two stories high, an operating house 162 x 46 ft. in plan and 178 ft. high, and a storage annex 136 x 105 ft. in plan and 100 ft. high. The whole structure is carried on a 3-ft. concrete mat supported on wooden piles, which were assumed in the design to be loaded to 25 tons each under full load. About 4,300 piles were driven.

The site of the elevator originally was a flat about 10 ft. above low-water level of the river, which is about 300 ft. away from the nearest part of the track shed. The entire surface of the terminal is being brought to El. +32 (zero being low water) by a hydraulic fill pumped in from the river. In constructing the elevator, excavation was made in the original bank to El. +4.5 and the entire area covered with piles spaced about 2 ft. 6 in. on center and from 40 to 45 ft. in length. On these piles the concrete mat 3 ft. thick was poured with the piles cut off at El. +5.0; that is, they had 6 in. embedment. On the mat, pedestals were erected to carry the elevator structure at the various levels shown in the accompanying cross-section. Under the storage annex and in most of the operating house pedestals are about 16.2 ft. long; that is, the bottom of the 15-in. floor of the structure is at El. +23.8. This 16-ft. space was then filled in with the hydraulic fill which is to be carried eventually to El. +32.

About the time the storage annex had reached two-thirds of its full height and when the operating house reached only 12 or 15 ft. above the ground a marked settlement was observed in the structures. The settlement began with the pumping in of the sand fill and continued from November, 1918, to May, 1919. Meanwhile pouring of concrete was under way but was suspended in January, 1919.

The subsidence, which was eventually stopped, as will be noted hereafter, amounted at its greatest to the following distances in feet: Maximum subsidence in the storage annex, northeast corner, 1.96; southwest corner, 0.76; southeast corner, 1.40; northwest corner, 1.15; operating house, southeast corner, 0.62; northeast corner, 1.72; track shed, 0.21 to 0.37. At the same time subsidence was occurring in other points on the hydraulic fill, as shown by the fact that trees 300 to 500 ft. from the elevator, on which benchmarks had been established, were found to have settled about 1 ft. The unit loading on the respective foundations at about this time—precise dates cannot be given because filling was going on all the time—amounted to about 15 tons per pile in the storage annex, 9 tons per pile in the operating house and 17 tons per pile in the track shed.

A board of five engineers, in January, 1919, was called together to advise the city how to stop the subsidence and safeguard the structure. This board in April, 1919, submitted a majority report, signed by F. W. Boschke, Robert A. Cummings and Howard T. Holmes, and a minority report signed by W. R. Phillips.



SECTIONS THROUGH GRAIN ELEVATOR SHOWING FOUNDATION CONDITIONS

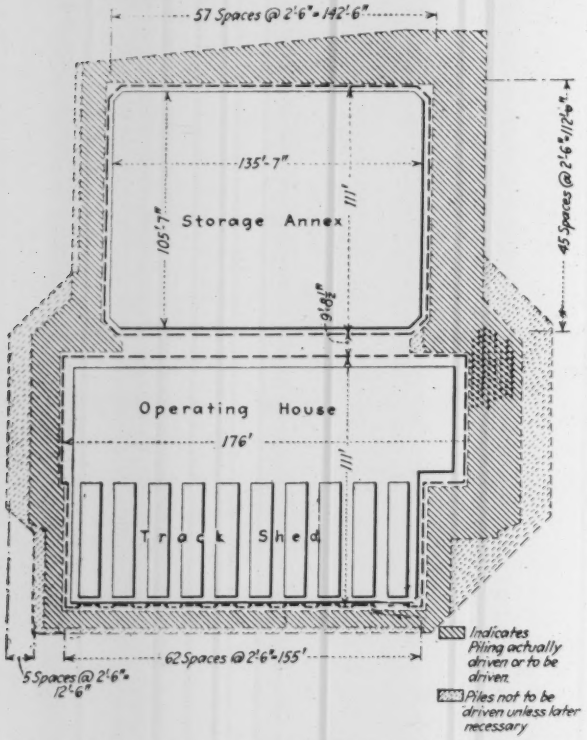
The majority report states that there were fourteen test piles driven before the foundation work on the elevator was started. These piles were fairly well distributed over the area, and ranged in length from 49.4 ft. up to 101 ft. and had penetrations up to a maximum of 78.8 ft. or to an elevation of –70. The board found, however, that in several instances even with these long piles the penetration under the last blow of the hammer, with that hammer falling as much as 25 ft., was very great, too great, in fact, to warrant the conclusion that piles even of this length would carry safely the load of 25 tons each through a soil of this character when grouped as closely as they were under the structures. They state that the piles as actually driven under the storage annex ranged from 40 to 45 ft. in length and that they are "unable to understand why this length of pile was selected rather than a longer length. It is our opinion that the first piles driven should have indicated the necessity for a further investigation as to the bearing power of the soil upon which the buildings were to be erected."

The report further states that in addition to the test piles driven there were certain borings made to determine the character of the subsoil. These borings were not made, however, until after the subsidence was known to have started and the information which the borings furnished was not conclusive largely because of the way in which the samples were removed from the pipe. The report states, however, that the consulting engineers feel that the borings were sufficient to indicate a subsoil of considerable fluidity which again would seem to indicate the necessity for obtaining more information. The report continues: "One pile located in the midst of a large number in the southeast corner of the storage annex was tested with a load of 80,000 lb. or 40 tons, approximately 1.6 times the load for which it was designed." At this point the report enters into a discussion of the theory of the foundations which reads as follows:

"The deduction seemed to be that if one pile loaded to this amount showed no subsidence, a large group of piles would be entirely safe when loaded to $\frac{1}{16}$ of that load. It is our opinion that this deduction is erroneous. We note that a small group of piles supporting the dock had been loaded by placing sand on the dock to as much as 60 or possibly 70 tons on each pile, and we have no information that any subsidence has taken place, but it is our opinion that this again should not be used as evidence that a large number of piles driven in a comparatively small area would stand anything like this amount of load per pile in a semi-fluid material of the character of this soil. The piles under the operating house and the storage annex were driven on 2 ft. 6 in. centers, consequently when the load was applied on this structure the actual effect was to get one large pile equivalent in area to the area of the storage annex plus the area of the operating house plus the intervening area between the buildings, and it is erroneous to assume that the bearing power of 4300 odd piles driven in this manner would sustain 4300 times the load which one pile will carry. The sustaining power of such a group of piles is limited to the skin friction or shear-

ing value of the perimeter of the entire mass, plus the bearing power of the area under that mass. The only remedy that seems to have been adopted at any time during the construction when it was discovered that these piles were driven too easily was to add more piles, which did not improve the situation. From the information furnished us by your engineers and from information which we have obtained in our investigation, we are of the opinion that below the slab there is no soil to a depth of –41 of such a character as will bear the uniform load of approximately 3.8 tons per square foot, which is the ultimate live-load and dead load of these two structures.

"Summarizing our conclusions as to the cause of the trouble, we would state that it is our opinion that too great a load per square foot was placed upon the foundation because of the character of the material at which the load was applied and the piles were driven so close together that they simply acted as a means to transfer the surface load to a point at an elevation –41, where the bearing value of the soil is at least no greater than that at the surface."



PLAN OF ELEVATOR SHOWING LOCATION OF PINCH PILES

Further studies by the board showed that a layer of clay 3 ft. or thereabouts thick lies below the old bank and that below that the soil is a soft sand or silt to a depth of somewhere around –160, where there is apparently a hard gravel.

In suggesting remedies the board first recommended that the surrounding soil be compressed by driving additional piles so as to increase the perimeter of the mass upon which the load bears and at the same time to increase the area of the base to which the load is finally transferred. This was suggested as a preliminary scheme which if it did not work could be followed by one of two methods suggested by the board. The first was to sink concrete cylinders under the present structure carrying the whole load to the gravel stratum with such reductions of loads thereto as could be safely carried by the superposed ground, and the second was to so spread foundations on which to float the entire structure, moving the operating house, however, to a new position. The minority report did not feel any of the piling or floating foundation schemes would serve and recommended that the cylinder foundation scheme be carried through.

After considering the various methods of stopping the subsidence, the plan of driving the so-called pinch piles, as recommended in the majority report of the board of engineers, was adopted by the city engineers. This provided for driving rows of piling outside of and parallel to the outer edges of the foundation piling. The first row was driven about 25 ft. away from the structure with succeeding rows inside the first one, thus gradually drawing in on the foundation.

As the maximum subsidence had occurred at the northeast corner of the storage annex, the first of the pinch piles was driven there. As soon as the first few piles were put down the subsidence stopped. It had previously been slowly but steadily going on for some time. As successive rows of pinch piling were put down the driving was more and more difficult as the work drew nearer to the structure. This effect was so pronounced that the number of rows originally contemplated was reduced along parts of the work. However, it was realized at the outset that no exact rule could be laid down and the arrangement with the contractor was that engineers of the dock commission would decide from time to time whether the amount of pinch piling should be increased or decreased.

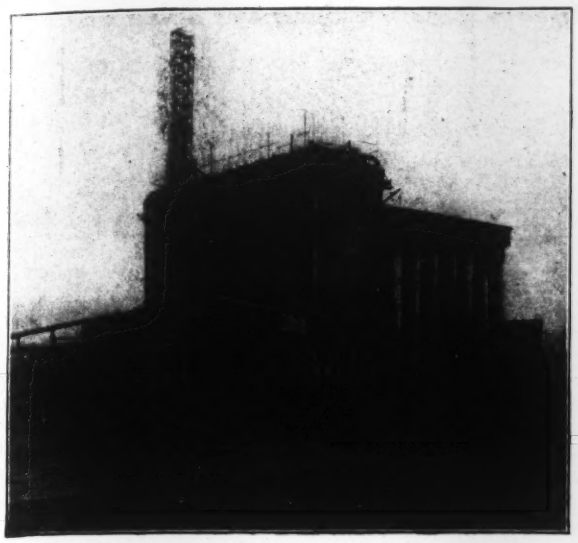
The foundation piles under the storage annex extend to a depth of 40 to 45 ft. below low-water level. The pinch piles were put down 15 to 20 ft. deeper than this, the first four or six outer rows being driven 5 ft. deeper than the remainder. The pinch piling is to be carried around all four sides of the storage annex, filling in the narrow strip between this structure and the operating house. The piling is also being carried around the outside of operating house and track shed, as shown in the accompanying plan, so that a complete enclosure of the foundation area will be effected. In this work a total of 2,684 piles are to be driven, of which 2,134 were in place by Dec. 15.

At the time of considering the plan of repair the following tabulations of existing loads and loads to be added were compiled for the three structures. All loads are expressed in pounds.

STORAGE ANNEX
(Concrete work finished to El. 121)

Part	Load to Date	Load to Be Added	Total
Concrete mat on piles, foundations work considered as 140 lb. per cu.ft.	6,760,800	.....	.....
Hydraulic fill	26,996,250	.....	.....
Concrete to El. 121	35,203,500	.....	.....
Fills in bin bottoms	3,239,900	.....	.....
Cupola forms	115,200	.....	.....
Cupola concrete	.....	1,406,800	.....
Wheat, 755,100 bu. at 60 lb.	.....	45,306,000	.....
Machinery and belts	.....	143,000	.....
Live-load on roof	.....	402,000	.....
	75,315,650	47,258,600	119,574,250

Loading at this time was 60.5 per cent of ultimate load and amounted to 14⅛ tons per pile in original foundation.



VIEW OF GRAIN ELEVATOR TAKEN OCT. 25, 1919

OPERATING HOUSE
(Work carried up to El. 58)

Part	Load to Date	Load to Be Added	Total Loading
Mat	4,070,000	.....	.....
Hydraulic fill	14,258,200	.....	.....
Concrete to El. 36	5,514,200	.....	.....
Concrete walls and columns to El. 58	2,110,000	.....	.....
Forms for bin deck	92,000	.....	.....
Concrete to top of house from El. 58 (less forms)	.....	27,486,400	.....
Bin fills	.....	1,383,000	.....
Wheat 329,000 bu. at 60 lb.	.....	19,740,000	.....
Live load on floors	.....	3,319,200	.....
Live load on roof	.....	227,000	.....
Total weights	26,044,400	52,155,600	78,200,000

Loading at this time was 33.4 per cent of total load, and amounted to 16.3 tons per pile in original foundation.

TRACK SHED
(Built up to El. 32 and 36)

Part	Load to Date	Load to Be Added	Total Loading
Concrete in footings	2,080,000	.....	.....
Hydraulic fill on footings, 32,500 cu.ft. at 120	3,900,000	.....	.....
Concrete to top of sack platform	7,750,000	.....	.....
Forms for cols. and roof	70,500	.....	.....
Live-load on floor	.....	848,000	.....
Concrete to top, less wt. of forms, 70,500 lb.	.....	1,679,500	.....
Wheat in hoppers, 18,000 bu. at 60 lb.	.....	1,080,000	.....
Live-load on roof at 20 lb. per sq.ft.	.....	176,000	.....
Total weights	13,800,500	3,783,500	17,584,000

Loading at this time was 78.5 per cent of total load and amounted to 17.5 tons per pile.

These analyses of the loads showed what a material increase there would be in the safety factor if the hydraulic fill on the footings were removed. This fill was therefore removed by sluicing and pumping from under all three structures. After the removal of the fill the openings around the space it occupied were walled up with concrete and finished with the cement gun.

The satisfactory condition of the foundation noted as it became more compacted has convinced the engineers in charge that the structures can be used just as was originally intended.

G. B. Hegardt, Chief Engineer of the Commission of Public Docks of Portland, has charge of the work on the grain elevator. G. W. Boschke is consulting engineer and Robert Wakefield holds the contract for driving the pinch piling. The elevator was designed by Witherspoon Englar & Co., elevator engineers, of Chicago.

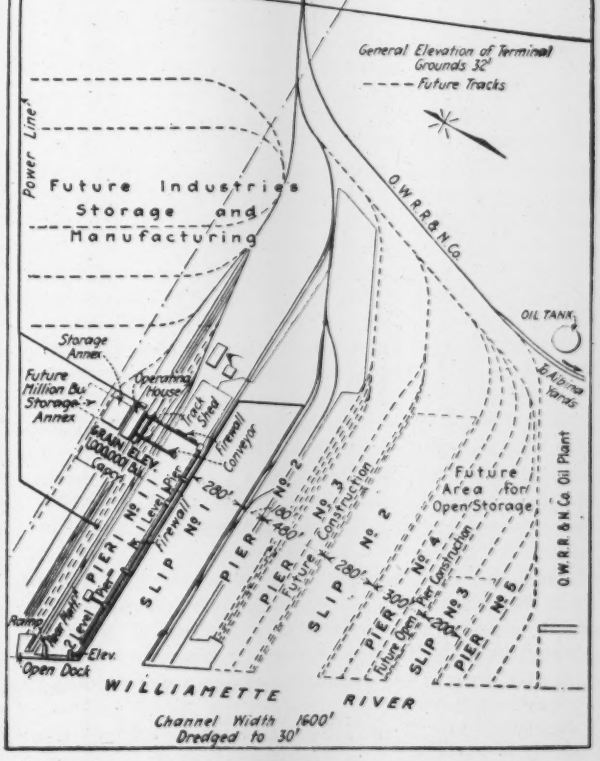
Municipal Grain and Freight Port Terminal at Portland, Ore.

City Is Completing Two Piers and a Large Grain Elevator on River Seven Miles Below Business District

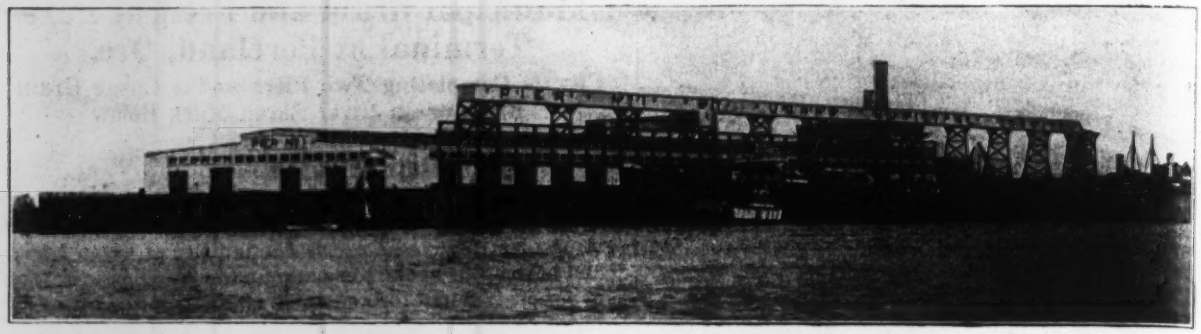
By W. P. Hardesty
617 Chamber of Commerce Building, Portland, Ore.

PACIFIC coast cities have been very much alive in the last few years to the possibilities of ocean trade and have spent and are spending many millions in developing their ports for the more efficient and economical handling of sea-borne freight. Portland, Ore., has been one of the leading communities in this respect, particularly in the extension of municipal construction and control. In 1910 the voters authorized the creation of a Commission of Public Docks to be appointed by the Mayor, and also authorized an issue of $2,500,000 of bonds for the acquirement of lands and construction of public docks. Under this plan two large modern docks have already been constructed and equipped. Under a bond issue of $3,000,000 in 1917, work is well under way on a large municipal terminal, which includes a grain elevator with necessary storage annexes as well as a freight terminal for more economical handling of bulk freight.

Portland has long been an important grain-shipping point, at times leading in annual grain shipments over any other port in the United States. The city has determinedly striven to maintain its standing as an ocean-shipping point for all classes of freight, although located



LAYOUT OF ST. JOHNS TERMINAL—PIERS 1 AND 2 AND GRAIN ELEVATOR NOW UNDER CONSTRUCTION



LOOKING NORTHERLY OVER THE COMPLETED PIER 1

110 miles inland, measured along the channels of the Columbia and Willamette Rivers. It has a big natural advantage in the Columbia River which affords water grades for railways far into the interior as well as to the ocean. For this reason the large wheat-growing sections of eastern Oregon and Washington are naturally tributary to the city.

Handling of grain in sacks only has been the practice at ocean-shipping points in Oregon and Washington until recently. This expensive method is now becoming out of date, both on account of the cost of handling and the cost of sacks, so that the provision of grain elevators for handling in bulk was seen to be a necessity.

The Commission, acting under instructions of the 1917 bond issue, selected a site at the extreme lower end of the city's frontage on the Willamette, at a point about seven miles from the center of town, and on the east side of the river. This point is only 3½ miles above the junction of the Willamette with the Columbia River, and 105 miles from the mouth of the latter. The location chosen, being at the lower end of St. Johns (an annexed town), the entire site, with all the facilities being created, has been designated as the "St. Johns Terminal." A body of land covering 153.55 acres, and having a frontage of 2,500 ft. on the Willamette, was purchased.

Of the tract, approximately 130 acres is naturally low-lying, being partly submerged by the river during floods. To render the site available it has been necessary to fill in, by hydraulic dredging from the river, all of the low land to be occupied, to an elevation of 32 ft. above low water. Nearly 3,000,000 cu.yd. of sand have been pumped in for this portion, and approximately 1,500,000 more will be required to complete to the contemplated high land elevation when all of the site is used.

At the site selected, the Willamette has a width of 1,600 ft. between harbor lines. To utilize the entire width of the river for a fairway for vessels using the terminal, the Port of Portland Commission (another municipal body) undertook to dredge the full width to a minimum depth of 30 ft., at low water. A 30-in. suction dredge has been used, free of charge to the project, and the dredged sand has been delivered at the shore, from which the Dock Commission extended the pipe line to where needed and performed all shore operations with its own force of laborers. By this means the cost to the project has been reduced to about 6½c. per cu.yd.

The St. Johns Terminal consists essentially of piers with ship slips, of a reinforced-concrete elevator embracing track-shed, operating house and a storage annex, of tanks for oil storage, and of open area for industrial and manufacturing concerns that may be established in the future.

The formation of the piers and slips has principally been the work of the Port of Portland, and the J. A. McEachran Co. A 20-in. suction dredge was furnished by the Port Commission at a cost of $300 to $400 per day and used in excavating the slips to a depth of 30 ft. below low water. Nearly 700,000 cu.yd. were dredged for Slip No. 1. The contract of the McEachran Co. included construction of Pier No. 1, as originally designed. This pier is to be 220 ft. wide by 1,500 ft. long, by the plans calling for its enlargement. It has a lower floor (20 ft. above low water), available except during a few weeks of high water, possible in each year. The upper floor, 35 ft. above low water, is available at all stages.

The pier is of wood construction, built as follows: A fill is made, reaching to the full height to support the upper floor for 74 ft. width at the northerly side of the pier, while on the southerly side the slope of the fill runs down at about 2 to 1 slope to 30 ft. depth below low water at the edge of the ship slip, a distance of 146 ft. For this latter portion of the width, the structure is supported on piles, while for the former the flooring is laid directly on the fill.

Above the main floor is erected a transit shed 180 ft. wide and running the full length of the pier, leaving an open platform 20 ft. wide on either side. The entire pier is divided into four parts by three fire walls extending across it at intervals of 600 ft., 300 ft., and 300 ft. The shed is of slow-burning construction, and is provided with a sprinkler system. The pier is equipped with movable ramps, with 45-ton and 15-ton railroad cranes, sacking bins, and all facilities for loading ocean-going vessels with grain. A shipping gallery, erected on top of the main structure, runs the full length of the pier, and it is equipped with two lines of belt conveyors, by which grain can be carried the full length to the river front, or be diverted by trippers for delivery to vessels anywhere along the adjacent slip.

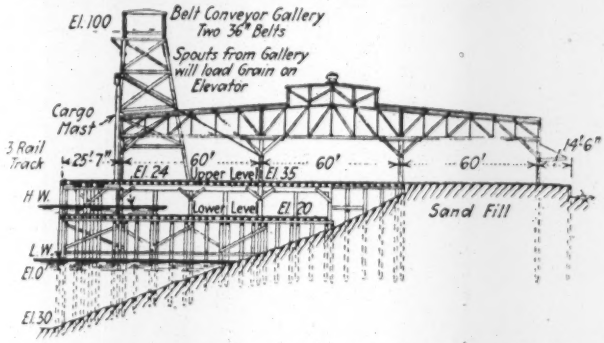
Next south of Pier 1 is Slip No. 1, 280 x 1,500 ft. and 30 ft. deep at low water. Adjoining it is Pier 2, also being completed at this time. This pier is an open dock, 180 x 1,500 ft. It will be equipped with gantry cranes for handling the heaviest loads, and with large steel tanks for handling bulk oil from the Orient and also molasses coming from the Hawaiian Islands.

At the easterly end of the slip is an open viaduct connecting Piers 1 and 2. This viaduct is virtually an end dock, giving loading facilities at end of the slip. It is intended, ultimately, to erect sheds on Piers 2 and 3, and to have open storage on Piers 4 and 5. Mechanical

appliances will be supplied for economical and rapid handling of the freight.

For the preparation of the plans, estimates, specifications and contract for the elevator, the Witherspoon-Englar Co., grain-elevator engineers of Chicago, were employed, and this work was done under the direction of the Commission at its office in Portland.

The elevator consists of a track shed 58 x 151 ft., with track space outside for 68 loaded cars, an operating house 162 ft. long, 46 ft. wide, and 178 ft. high, and the storage annex 136 ft. long, 105 ft. wide, and 100 ft. high. All these structures are of reinforced concrete.



TYPICAL TRANSVERSE SECTION THROUGH TWO-LEVEL SECTION OF PIER 1

The operating house has 79 bins of varying size and an aggregate capacity of 298,700 bushels. The storage annex consists of 63 bins of 15 ft. diameter, and 85 ft. height, and capacity varying from 10,300 to 12,200 bushels each, and 36 inter-space bins holding 2,200 bushels each, giving a total bin capacity of 755,100 bushels. The total storage is thus 1,053,800 bushels, and connections are arranged for an additional storage annex to be built in the future and holding 1,000,000 bushels more. The operating house has machinery for handling this increased storage. It is estimated that the handling capacity will then be 10,000,000 to 12,000,000 bushels annually. The unloading capacity is 120,000 bushels per day, while loading can be done at 20,000 bushels per hour.

Electric power is used throughout in the operation of the plant. Each unit can be operated independently, and electric signals and telephones are used throughout the plant.

For the foundation the entire area was excavated to about 4 ft. above low water. Piles were then driven, spaced 2½ ft. c. to c. normally, but closer where the ground was quite soft. The formation here is mostly silt. Piles averaging 40 to 50 ft. cutoff were driven, 204,000 lin.ft., at 22½c. per foot, being required. On the pile foundation a 3-ft. reinforced-concrete slab was laid, reaching 6 in. down over the tops of the piles. On this slab were erected pedestals or columns, reaching up to the proper heights to support the different basement floor levels.

The space between the foundation slab and the basement floors was filled in with sand pumped from the river. The basement floors, being below the high-water level, were waterproofed by a thick layer of waterproofing material, embedded in the concrete, and this waterproofing was extended up the walls to elevation 32 ft. above low water.

The elevator work was let in one contract, excluding, however, the excavation and the driving of piling, and also the filling in above the concrete slab before-mentioned.

Early in 1919 there was some trouble with subsidence in the elevator, which is now being corrected by the driving of extra piles. The difficulties are described in an article on p. 176 of this issue.

Special Form of Base-Price Contract

The contract for construction of the main elevator, and also the contract of the J. A. McEachran Co., for Pier No. 1, had some unusual features. Owing to rapidly fluctuating prices due to war conditions it was decided to provide for a base price for every item of material and labor, and to allow for current variations in cost of these items. A series of elaborate schedules for the different classes of labor and materials was incorporated in the proposal and contract, and the bidder named a base rate for each item. The schedules for the grain elevator contract include:

(1) Scale of wages at the site, Portland and vicinity. Under this are the subdivisions of Building Trades Work (with a long list covering all occupations concerned), Machine Shop Work, Sheet Metal Shop Work, and Foundry Work. The wages for an ordinary 8-hr. day, and also for overtime, holidays and Sundays (usually double) were designated by the Commission.

(2) Government prices for materials, f.o.b. Pittsburgh, Pa., these being inserted by the bidder. The prices per ton for pig iron, sheets, plates and shapes, and per pound for shafting, brass and babbitt, were called for.

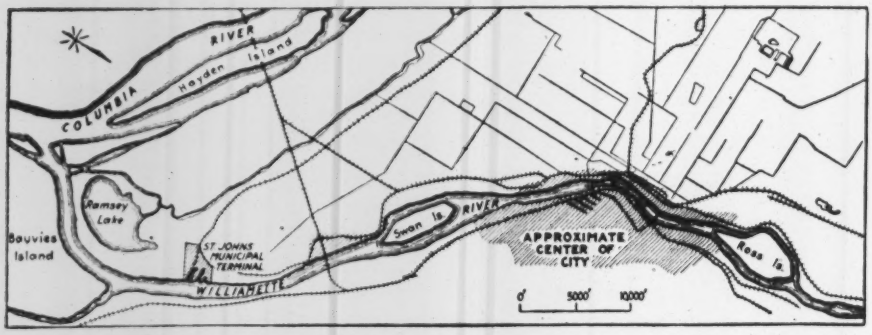
(3) Scale of wages per hour for fabricating said materials. These were inserted by the bidder, and covered the occupations in Machine Shop Work, Sheet Metal Shop Work, and Foundry Work.

(4) Cost of freight on the fabricated products. No schedule of rates was inserted, it being considered unnecessary, as the rates are not subject to dispute.

This contract operated as follows: (1) No variation was made in the pay to the contractor if none of the prices changed in the foregoing schedules (they being current at the time bids were advertised for), but the contractor was paid for the finished work at the lump price bid therefor. (2) For increase in any schedule prices the contractor was allowed for the increase in cost to him over what it would have been if there had been no such increase in rates. (3) For any decrease in schedule rates the compensation to the contractor was reduced correspondingly.

Fixing of reasonable time limits was, of course, necessary to cover the purchase and fabrication of materials Running from the date of the contract, 30 calendar days was fixed as a reasonable length of time within which the contractor and all of his subcontractors (manufacturers) should purchase materials, and 135 days was fixed as a reasonable time in which to complete the fabrication of the said materials. The contractor was not entitled to any increases which occurred after the time limits fixed above.

As to variation in freight rates, the contractor was not entitled to compensation for any increases which occurred unless the fabricated material was transported within sufficient time to allow for the installation of the same, and the completion of the contract in time. The time limit for the completed work was 225 days.



MAP SHOWING LOCATION OF ST. JOHNS TERMINAL, THE MUNICIPAL PORT PROJECT AT PORTLAND, ORE.

Manifestly, this contract required a very full cost-keeping record for the Commission. All original bills for material were submitted and checked, and the time of employees was carefully kept. The going cost of labor at the elevator site was determined by the Commission, being based on prevailing rates of wages, and the contractor was required to apply to the Commission and secure approval of any proposed increased rates of pay before he was given credit for them. The going cost of materials at Pittsburgh, and the going cost of fabricating same was determined by responsible agencies employed by the Commission. The changes in freight rates were taken from the tariffs.

The contract for the elevator and appurtenances was awarded on April 9, 1918, to Grant Smith & Co., of Portland, the estimated amount (base price) being $798,383.

The reinforcing steel and the cement were furnished by the Commission, without charge to the contractor, and were delivered at the site. The Commission bent the steel to the required shapes at one of the municipal docks in the city, which served as a storeyard for it. Following are the kinds of material and equipment furnished by the Commission, together with the amounts paid to the manufacturers:

Reinforcing steel	$93,030
Cement	85,100
Motors and transformers	31,965
Rubber belting	41,000
Grain-cleaning machinery	7,600
	$258,695

Of the contracts before mentioned, that of the J. A. McEachran Co., for Pier 1 was completed in good time, and in excellent shape. As the work of Grant Smith & Co. on the elevator was shut down because of the foundation difficulties, it became necessary to release this contractor, so that on June 28, 1919, the contract was rescinded. The contractor was paid for work done, and material on hand, and a portion of the working equipment was also taken over. Since that time the Commission has carried on all the work on the elevator (including treatment of foundations) by day labor.

The completion of Pier 1 (embracing all of the enlargement over the original plan) and the construction of Pier 2 and the connecting viaduct were let in two contracts—the substructure to Elliott & Scoggin, and the superstructure to J. M. Dugan & Co., both of Portland.

All shore work in the general filling-in and other work over the terminal site, including construction of connecting railway tracks, was done by day labor.

On account of the enlargement of the terminal plan and because of rapid advances in cost of construction, more funds were needed, and in November, 1918, the voters authorized a further issue of $5,000,000. The entire cost of the project as outlined, when completed early in the spring of 1920, will probably amount to nearly $4,000,000.

The general design and construction of the St. Johns Terminal layout have been under general charge of G. B. Hegardt, the engineer of the Commission. The assistant engineer in immediate charge of most of the work has been George S. Edmonstone. Beginning with resumption of work after the foundation difficulties developed, the construction has been under supervision of George W. Boschke, a member of the commission of consulting engineers called in to report on the foundation difficulties. To the gentlemen named, the writer is indebted for data from which this article has been prepared.

Railway System of South America Needs New Links

Desirable Connections Include a Trunk Line for Colombia, a Bolivia-Brazil Line and a Brazilian Coast Line

By F. B. Morris
General Drafting Co., New York City

RAPID and modern transportation being the great need for early development of South America's commerce and natural resources, the question arises as to what are the more important of the immediate requirements. Having spent the past 15 years on railroad exploration, reconnaissance and definite studies in six of the South American republics, I will mention three railroad lines, or systems, which in my estimation appear to be absolutely necessary. These are mentioned in the order of their importance.

Bolivia to the Paraguay River

The first of these lines is an extension from Cochabamba, Bolivia, east to the Paraguay River, connecting with the present Northwestern Railroad of Brazil, and having a branch line north through Santa Cruz to Trinidad or other port accessible to river navigation on the upper Mamore River. Cochabamba is the second city of Bolivia and has direct rail communication with La Paz, Bolivia, and Antofagasta, Chile.

This new trunk line, approximately 700 miles in length, would descend the Rio Grande to the vast plain known as the Gran Chaco at the eastern base of the Andes, about 280 miles. This stretch would be somewhat costly, but on the next stretch of 429 miles to the Paraguay River, the construction could be accomplished at remarkably low cost. In crossing the Gran Chaco, the line should hold to the north, in order to serve the rich agricultural district along the slopes of the mountain ranges known as Sierra Santiago and Sierra San Jose. Thence it should go diagonally across the Chaco,

MAP SHOWS THREE PROPOSED LINKS IN THE SOUTH AMERICAN RAILWAY SYSTEM

a fertile land suitable for the cattle, timber and agricultural industries, to Puerto Pacheco, which is a good and deep river port on the Paraguay River.

Puerto Pacheco, or Bahia Negra as it is known along the river, is in the possession of Paraguay and within the zone of territorial dispute between Bolivia and Paraguay. It is considered probable, however, that an early amicable settlement of this boundary dispute will permit Bolivian occupation of the port. Thence the line should follow up the river for about 100 miles to connect with the Northwestern Railroad of Brazil at its present terminus at Porto Esperanca, which is the logical point for crossing the river. The construction of this railroad would give a trans-continental line through the center of Bolivia and link the Paraguay river ports with the Brazilian ports on the Atlantic and the Chilean and Peruvian ports on the Pacific.

The branch should leave the trunk line at the point where it first reaches the Gran Chaco and run north to Santa Cruz, then follow the Rio Grande to the selected port, probably Trinidad, an approximate distance of 380 miles. This line can be constructed very cheaply. The northern Bolivian rubber would thus be shipped to either Atlantic or Pacific ports. This branch would also connect Bolivia with the ocean steamship service on the Amazon River by way of the upper Mamore River and the Madera-Mamore Railroad.

Bogota to the Atlantic

The second railroad is a line from Bogota, the capital of Colombia, north to the Atlantic port at Baranquilla or Cartagena, about 560 miles. This line is practically a necessity to the progress and development of Colombia. Under the most favorable conditions Bogota is sometimes reached from the coast in 10 to 15 days, though the voyage frequently requires 20 days.

The present railroad from Bogota to Nemocon, 37 miles, could be revised and utilized as a part of this line, by ascending from Nemocon to the Ubate Pass, thence on a reasonably light grade, down into the valley of the Magdalena, where the grade would be only that of the river. The only heavy construction would be encountered on the stretch from the Ubate Pass into the valley and would be facilitated by the present steamboat navigation on the Magdalena River.

This railroad would place Bogota within 20 hours of the Colombian ports on the Caribbean Sea and give an outlet to practically the entire settled portion of the republic. In addition it would offer inducement for connecting many of the existing short railways with this main line, as well as for the construction of other feeders. A point worthy of mention is the good grade of coal now being mined along the Bogota-Nemocon Railroad, which would probably solve the fuel problem, provide freight for the railroad and fuel for ships.

Brazilian Coast Line

The third projected railroad is a low-grade line along the Atlantic coast in Brazil, connecting Pernambuco with Montevideo, Uruguay, and passing through Rio de Janeiro. This is one of Brazil's greatest transportation needs and could be accomplished by connecting existing lines north of Rio de Janeiro and constructing a new line south of that city. These present lines are as a rule well constructed, and linking them into a trunk line would not necessitate prohibitively costly revisions. The existing lines which connect Rio with Montevideo cannot compete with ocean steamships on account of the excessive grades, curvature and distance. This new coast line, if properly constructed, would place Rio within 1275 miles (40 hours) of Pernambuco, and 1350 miles (43 hours) of Montevideo. It could afford to handle traffic at a rate that would assure the carrying of the greater part of the commerce, which in this instance is awaiting the completion of such a railroad, while the many existing lines reaching from the coast into the interior would form valuable feeder lines.

Railroad construction in South America has in many instances been governed by limited capital, the result being that after construction the lines could not compete successfully with river navigation, wagons and pack trains, because of the high cost of operation due to excessive grades and curvature and therefore necessarily high tariffs. In practically every instance where these excessive curves and grades have been used, both in the Andes regions and in the eastern Brazil district, they were considered necessary on account of the crossing of mountain ranges.

It is in these same mountain districts that the enormous undeveloped water power of the continent lies. In making future studies of railroads, it would appear advisable to attempt to place all of the steep grades in one section and seek adjacent water power for the hydro-electric operation of that particular section. This would be preferable to the use of switchbacks, racks or pusher engines. At the same time, this method would considerably reduce the length of line and cost of the construction.

Topeka, Not Kansas City

In the article, "Through Concrete Arch Bridge to Give Large Waterway," by F. W. Epps, published in ENGINEERING NEWS-RECORD, Dec. 11-18, page 994, an error was made in editing the manuscript in this office. Topeka, Kan., instead of Kansas City, Mo., should have been named as the site of the work.

What Is the Future of Inland Water Transportation?—*Part IV*

By Charles Whiting Baker
Consulting Editor, Engineering News-Record

France and Germany have gone further than any other countries in the development of inland waterways. They have kept water transportation alive by compelling the railways to charge considerably higher rates than the boat lines. Part of the success of water transport in Europe is due to conditions differing widely from those in the United States, but on the whole the waterways of the two countries cost the taxpayers more than the public gains in reduced cost of transport. As American railway rates are lower than European water transport rates, there is no reason for copying French or German waterway policy here.

An analysis of the cost of bulk-freight transport on American railways of heavy traffic shows that the cost for movement over the road alone, on such lines as compete with waterways, is less than two mills per ton-mile. Only under most favorable conditions can freight be moved by river or canal at a lower cost. Still more important is the fact that terminal expenses and not the cost of hauling between terminals is now the controlling element, and on most freight the terminal expenses are far less by rail than by water.

The fact that railway rates are lower where there was water competition has long been a stock argument of waterway advocates. These rates are a survival from past conditions. The removal of this discrimination in favor of river and coast cities is now fought, not by the railways but by the cities themselves.

IX—Continued from page 144

Inland Water Transportation in Europe

"The United States should develop its inland waterways because the great industrial nations of Europe, especially France and Germany, have long followed this policy and now use inland water transportation to a far greater extent than the United States."

That is substantially the argument which has been used for many years in advocacy of Federal appropriations for waterway improvement; and it deserves fair consideration. It is easy to go to Europe and come back wonderfully impressed with the value and importance of inland water transportation there. We are all impressed with what we see on the surface. Few take the time and trouble to investigate underlying conditions.

It is not merely the casual traveler who comes back from Europe an enthusiast on inland water transportation. Men have gone on official trips of investigation and returned convinced that the United States ought to imitate the work of the European waterway engineers. In fact a good share of the work on canals and the improvement of navigable rivers which has been done in the United States has been copied from European practice.

Rail and Water Competition in Europe

In Europe as in the United States, the development of the railway during the last century brought about keen competition with the water transport lines; and in Europe as in the United States the railways at an early day rapidly got the better of the waterways. In Europe, however, the waterways were far more strongly intrenched than in the United States. The canals and navigable rivers of Europe were the chief means of inland transportation when the railway era began, and had been for centuries. Rivers had determined the location of cities and industries and commercial routes. Wars had been waged over the control of rivers; and rights to their use had been incorporated in international treaties.

Nevertheless the railways of continental Europe had by 1870 demonstrated their ability to compete successfully with the canals and rivers and the battle for supremacy began. Public sentiment was largely on the side of the waterway, as a road open to everyone and against the railway as essentially a monopoly. There was a general belief that the railways were superseding the waterways because the latter were too small for the traffic; and it was held that the Government should develop the water transport facilities.

Government Expenditures on Waterways

Both Germany and France embarked in the '70s on a broad policy of waterway improvement at public expense. France up to 1900 had spent on its rivers and canals, aggregating about 7500 miles in extent, $300,000,000 for construction and improvement and nearly $150,000,000 for maintenance and repairs. In Germany the state of Prussia alone had spent on the construction of waterways, by 1906, about $200,000,000 besides contributing largely toward their maintenance and operation.

If one desires to compare the relative cost of railway and water transportation in France and Germany, therefore, he must take into consideration not merely the relative freight rates by rail and by water but the part of the cost by carriage which has been contributed by the taxpayers through the public treasury.

There is only one American investigator who has attempted this. Prof. Harold G. Moulton, now of the Economics Department of the University of Chicago, undertook in 1911 a study of the comparative economy of railway and waterway transportation; and he went to Europe to study conditions there. His book "Water-

ways vs. Railways," published in 1912, was awarded a prize of $1000 by a committee of eminent economists. It is the most thorough review of this subject that has ever appeared.

The facts and figures given by Prof. Moulton are closely parallel to those reported by another investigator, Mr. E. O. Merchant, in an appendix on European Waterways forming part of the report of the National Waterways Commission, issued in 1912.

Railways Prevented From Lowering Rates

In both Germany and France the Government has prevented the boat lines from being driven out of business by railway competition by compelling the railways to maintain their rates considerably above the water transport rates. In France, the Government bears the entire expense of maintaining and operating the waterways, no tolls being charged. Prof. Moulton finds that the waterway system of France costs the taxpayers about $19,000,000 per year. This is made up of interest on $360,000,000 capital invested at 4% plus the annual expense of operation and maintenance, between $4,000,000 and $5,000,000. The total traffic on all French waterways in 1905 was 3,348,000,000 ton-miles. Hence the average cost to the taxpayers of the freight carried on French waterways was about 5.7 mills per ton-mile. The average freight rates charged by the barges are 4 mills per ton-mile, or a total of 9.7 mills per ton-mile. The average freight rate on all French railways in 1905 was about 13 mills per ton-mile. The waterways, however, handle chiefly low class freight on which the cost of handling by rail is much less than on the average freight carried. Were the arbitrary differential not maintained, therefore, the railways could carry the freight more cheaply than the waterways.

These are, however, comparisons merely by broad averages. When the situation is studied in detail it is found that the French waterways vary greatly in traffic importance. The Seine river, for example, is navigable from Paris to the sea by barges of 1100 tons capacity. Coal from Wales, foreign grain and other low grade freight, are brought to Paris from the seaboard in vast amounts. The Seine traffic is in fact nearly a third of the entire waterway traffic of France. Most of the French rivers and canals have a very light traffic. The Government outlay on their maintenance is closely parallel to the expenditure by the United States on inland rivers where navigation has practically ceased.

One of the best authorities in the world on the comparative economy of rail and water transportation is the eminent French engineer, M. Colson, General Inspector of Bridges and Highways in the French Department of Public Works. M. Colson has for many years opposed the French Government's outlay on waterways, especially those where the traffic is small. Prof. Moulton quotes M. Colson as declaring that the Government outlay on the waterways of central and southern France is "an absolute waste." The stock argument that waterways are necessary to relieve the railways from the burden of handling low grade bulk traffic M. Colson meets with the declaration that "There is absolutely no question as to the ability of the railways to care for all the traffic of the country. It is absurd to hold that the waterways are an indispensable aid to the railways."

No such direct comparison is possible of water and rail transport results in Germany as that just stated for France, for the German waterways are largely under control of the separate states. Further than this, certain of the German waterways are more favorably situated for traffic than those of any other country. The Rhine has the greatest traffic of any inland waterway in the world, aggregating before the war, 22,000,000 tons per annum. It extends from the great ocean port of Rotterdam southward nearly 400 miles through the most densely populated region on the globe. It is navigable for 2000-ton barges for 250 miles. Its flow is remarkably uniform throughout the year, as it is fed during the summer months by the melting glaciers in the Swiss mountains. Its average closure by ice is only 17 days in the year. It traverses the famous Westphalian coal fields. Vast industries have grown up all along its course, which use the river for transportation.

Of the total traffic on all the German waterways, 7582 miles in extent, 43% was moved on the 355 miles of the Rhine in German territory.

The Elbe river, which reaches from the great port of Hamburg inland 386 miles to the Austrian frontier, carries another 24% of the total German waterway traffic so that these two rivers carry two-thirds of all the water traffic of Germany. To lump the statistics of traffic on these large rivers with those of the smaller rivers and artificial canals to prove that the whole German waterway system is an economical transportation proposition is misleading.

The Dortmund-Ems Canal

Prof. Moulton analyzes the traffic statistics of Germany's most important inland canal, the Dortmund-Ems, which gives an outlet for coal from Westphalia to the North Sea. This canal is 153 miles long and accommodates 600-ton barges. Its total cost to April 1, 1906, was $24,493,000. In 1905 it carried 1,518,000 tons and its deficit was $908,359, so that the cost to the taxpayers was about 60 cents per ton carried. The water freight rate plus the tolls and harbor dues added to this makes a total cost of $1.74 per ton, or about 1.4 cents per ton-mile for all freight carried on the canal. The German railway rate on coal is about 1 cent per ton-mile. Thus even under the German conditions, the railway transport is cheaper than the canal transport when all the items of cost are included. Of course, if the comparison were made with American railway rates on coal and similar low grade freight the fact that the waterway is a far more costly means of transport than the railway would be still more evident.

In the Kingdom of Prussia, a direct comparison is possible between the financial results from the state-owned and operated railways and the state-owned and operated waterways. Up to April 1, 1906, there had been expended on the improvement of Prussian waterways $198,420,000 covering 2324 miles of open rivers and 1508 miles of canals and canalized rivers. These cost the taxpayers in that year for interest on their cost at 3½%, sinking fund and deficit in operating expenses over earnings, the sum of $13,498,777, an average of $3523 per mile of waterway. In the same year the State railways of Prussia, 31,319 miles in extent, after paying interest and sinking fund charges on their bonded debt of $1,518,400,000 earned a net profit for the State of $56,900,000, which was 2.57% on the total capitalization after interest charges on the investment were paid, or an average profit, after paying interest on the cost, of $1814 per mile of railway.

It is a well known fact that the policy of the German Government for the past half century has been to promote in every possible way the use of waterways. The Government-owned railways have their rates so controlled as to divert traffic to the waterways. The Government stands the cost of maintaining all the rivers and canals, charges very small tolls on the canals, much less than the cost of maintenance and operation, and none at all on the canalized rivers. The Government also stands most of the cost of freight transfers between rail and water lines, and the wharfage dues charged by cities are usually much below the interest and maintenance cost on the municipal water terminals. Thus water transportation is heavily subsidized at the taxpayers' expense, while the railways return a large profit to the public treasury.

The "coördination of the railways and the waterways," which has been held up as an ideal for the United States, has been effectively carried out in Germany for many years; but that this "coördination" has operated to benefit the public remains to be proved. It would seem too obvious to require any argument that wherever the total cost of water transportation is greater than the cost of rail transportation the public is injured and not benefited if it is compelled to use the more costly route. German official literature is strangely silent, however, on this important point. In that country, as in the United States, the *assumption* that water transport is inherently cheaper than rail transport is the basis on which vast sums of the taxpayers' money are expended.

There is one isolated case, however, where the German propensity for investigation got the better of the Government policy. In 1909, Dr. Walter Rathenau and Prof. Wm. Cauer of Berlin, published the results of an investigation to determine whether freight could be carried more cheaply by the proposed Rhine-Elbe canal or by a railway. They found that the canal rates would have to be fully double the rail rates if they covered the cost of making and maintaining the waterway as well as the cost of haulage. They also found that the railway would have much greater traffic capacity than the 600-ton barge canal. It does not appear, however, that this investigation had any effect on the German Government's waterway policy.

The Kaiser and German Waterways

Half a dozen years ago it would have been considered sufficient proof of the soundness of an economic policy that the German Government had adopted it. The world has learned some lessons since then as to the infallibility of the German Government. It is, however, exceedingly interesting, in the light of present knowledge, to note what Prof. Moulton said in his book, published two years before the world war.

After demonstrating conclusively from official figures that a good share of the waterways of Germany are costing the taxpayers more than the benefit they confer in lowering the cost of freight transport, Prof. Moulton continues:

> Is it possible that the German waterway officials and the German people themselves can be unaware of the economic losses involved in waterway expenditure? Is there something back of the scenes, some dominating force which virtually compels the Government to continue the policy of subsidizing the waterways?

After a careful first hand study of German waterways, M. Colson asserts that Kaiser Wilhelm is the power behind the movement. The Kaiser, it is said, believed that Germany's future is dependent on the development of her sea power and he is "suffering from a delusion" that the development of inland navigation is an absolute essential to the expansion of ocean commerce. Now, it is well known that when the Kaiser's mind is made up—when he has received an "inspiration," as the Germans themselves say, it matters not if sound arguments are wanting. In 1890 the Kaiser dismissed 20 members of the Prussian upper house who had voted against the canal bills and appointed 20 men to take their places who were favorable to waterways development.

There is one fact of extreme importance which must be always borne in mind in any consideration of European water transport as a guide to our policy here. That is the low cost of railway transport of bulk freight in the United States compared with Europe. If the figures for cost of transportation per ton-mile on European waterways are examined, they will be found to be in most cases higher than American railway rates on low grade freight hauled an equal distance, and this notwithstanding the much lower labor cost in Europe.

European comparisons between railway and waterway transportation are not applicable to American conditions, for the evolution of the railway as an economic carrier of bulk freight has proceeded much farther in the United States than in any other country in the world. Even if the government policy of France and Germany toward their waterways were sound, it does not at all follow that it would be a wise policy for the United States to adopt.

In concluding this chapter, special emphasis deserves to be laid on the unreliable character of a good share of the engineering literature on water transportation, especially that coming from foreign sources, where the old traditions as to the value and importance of water transport die hard.

An extreme example was related by a member of the delegation of American engineers who were invited to France early in 1919 to advise on a reconstruction program. Among the projects submitted to them for approval and urged with great force and eloquence by a Colonel holding high rank in the French Department of Public Works was a proposed very costly waterway to reach a well known city now without water transport. The American engineers inquired what was the principal industry of the city and the reply was, "the manufacture of watches!"

X—The Cost of Rail Transport and Water Transport Compared

The sole justification for the expenditure by the Government on the improvement of inland waterways is the belief that water transportation is cheaper than rail transportation. If this is not the case—if on any particular waterway the total cost of transportation is greater than the cost of sending the goods by rail—it is evident that the waterway will not be used, and the money spent on its improvement for navigation will be wasted.

The time has come when this question must receive impartial investigation and answer. Hitherto the situation has been confused by the prevalent idea that the waterway was needed to protect the public from the railway "monopoly." The waterway advocates of half a century ago said: "The railway can charge us rates based on 'what the traffic will bear' and all that it

will bear; and because it is a monopoly we are helpless. Give us a waterway and we have a road that is free for every man to use; one which no monopoly can control. We will then be protected from railway extortion."

That is really the foundation on which was based the campaign in favor of waterways and the expenditure of hundreds of millions on waterway development which has resulted.

This foundation has now been swept away. Experience has demonstrated, in the first place, that the individual boat owner on the river or lake is too small and too weak to survive in the competition with the big railway corporation. Experience has demonstrated, in the second place, that even where water transportation still survives, as on the Great Lakes, a few big strong concerns can absorb the small companies, and there is no possible way of preventing combinations between them, actual or tacit, to limit competition. Finally, experience has demonstrated that the railways at the present time, instead of charging extortionate rates for their service, are not charging enough to save themselves from bankruptcy. The long-standing argument that waterways are necessary to keep down railway rates is now demonstrated to be based on a fallacy.

The waterway is thus shown to be useless to protect the public against monopoly; and we can face fairly the question, Can the waterway actually transport goods cheaper than the railway?

Waterway Competition on Low-Grade Freight

The first step in answering this question is to determine what sort of goods the waterway is best fitted to transport in competition with the railways. Most waterway advocates agree that it is only on low-grade bulk freight that the boat can compete with the railway. On all the inland waterways of the world where business still survives, the traffic carried is nearly all of this class: Coal, ore, stone, lumber, ice, brick, grain. On these and similar low-value commodities the water carrier must rely for its business.

It is easy to see why. On these commodities the cost of carriage is very large in proportion to their value, and if the waterway can make a saving over the railway it is of much importance; but on high-class goods the value per ton is so great that if any saving is made by shipping by boat it is so small that other matters overbalance it. The greater risk of loss by water carriage and the greater risk of delay are alone sufficient to route nearly all merchandise shipments by rail instead of by water, wherever there is a choice.

Large Volume of Business Necessary

Furthermore, in order that water transport shall show a saving over the railway it must handle a great volume of business. Bulk freight of the classes indicated can only be handled economically by the provision of elaborate terminals and machinery for operating, and it takes a very large traffic to justify the investment in such terminals. It takes a huge traffic, also, to justify the expenditure on the waterway itself. The Ohio River improvements will represent a total investment by the Government of about $100,000 per mile. The Mississippi below St. Louis has absorbed as much. New York's new canal system has cost nearly $300,000 per mile.

The question narrows down, then, to the relative cost of rail and water transport for low-grade bulk freights handled in great volume. The railway of today handles such shipments in cars of 50-ton to 100-ton capacity. On railways paralleling water routes and having easy grades, such cars can be made up in trains carrying 2000 to 3000 tons or more of paying freight. What does it cost a railway to haul such freight over the road, apart from terminal expenses? For an accurate answer to this question, we should have to inquire into the special conditions in the particular road in question. The published official statistics, however, enable a general answer to be made.

The Hon. Robert W. Woolley of the Interstate Commerce Commission, in an elaborate statement submitted to a Senate committee Feb. 1, 1919, showed that the average cost of moving a railway freight car a mile over the road in 1916, including interest at 6% on the entire investment in the railway, but excluding the operating expenses at the railway terminals, was 11.37c. Of this amount about two-thirds was the cost of operation, the remaining one-third being interest on the investment and taxes. This reduces the cost of car movement to 7.58c. per mile, as an average of all traffic handled on all railways. It includes freight hauled over mountain railways with steep grades and the traffic carried on the many thousands of miles of branch-line railways where the traffic is not heavy enough to permit handling in large trains at low cost. This figure, then, is certainly higher than the average cost of hauling cars in full trains on roads of easy grades.

We are justified in assuming an average car loading as high as 40 tons, for though this is higher than the average car loading on all railways, it is lower than the loading where full trains of large-capacity cars are handled. At this rate, the average ton-mile operating expense on road haul alone, on all the railways of the United States, including all the expenditure on maintenance of way, was 1.89 mills per ton-mile in 1916.

Actual Costs on 11 Important Railways

Let us now compare this figure, representing the general average for the entire United States, with some figures taken from the official reports of individual railway companies which handle a heavy traffic.

The railways shown in the accompanying table have a comparatively small mileage of branches, so that the figures represent chiefly main-line operation. The second column in the table is the average freight charges per ton-mile on all freight moved over the railway in 1916. This includes, of course, high-class merchandise and less-than-carload freight, but on all the roads except the last (the Chicago & Alton) the great bulk of the traffic is in ore or coal.

The third column in the table shows the percentage the operating expense is of the gross earnings on the road named; the fourth column, obtained from the preceding two by computation, shows the railway's operating expenses per ton-mile. This computation leaves out of account the passenger business, and would be strictly correct only if the percentage of operating expenses to earnings were the same on passenger business as on freight. As a matter of fact, on most American railways the profits are earned on the freight business, and there is little money in carrying pas-

sengers. On most of the roads in the table, however, the passenger business is so small compared with the freight that the error in overstating the cost of haulage is not great.

The figures in column 4 include all the terminal expenses of the railways as well as the cost of hauling the freight over the road. Mr. R. W. Woolley, in the statement above referred to, says that an examination of the Interstate Commerce Commission's statistics shows that of the entire railway freight operating expenses on all the railways of the United States, one-third is assignable to expenses in operating terminals. Column 5 of the table has been computed on this assumption, and shows the actual operating cost of hauling a ton of freight over the road on the railways in question, including the cost of maintaining the roadway. These figures check very well with the general average of 1.89 mills per ton-mile obtained above from Mr. Woolley's figures.

TABLE SHOWING AVERAGE COST PER TON-MILE OF HAULING FREIGHT OVER HEAVY TRAFFIC RAILWAYS IN 1916

Name of Road	Miles Operated	Revenue per Ton-Mile, Mills	Per Cent. Operating Expenses to Earnings	Total Cost per Ton-Mile, Mills	Cost per Ton-Mile for Haul Over Road, Mills
Bessemer and Lake Erie	204	4 50	51 87	2 33	1 56
Western Maryland	688	5 01	64 40	3 22	2 08
Chicago & Erie	269	4 38	61 41	2 70	1 80
Hocking Valley	350	4 06	66 84	2 68	1 78
Toledo & Ohio Central	575	4 00	74 59	2 98	1 98
Kanawha & Michigan	176	3 82	62 77	2 39	1 60
Chesapeake & Ohio	2,385	3 80	65 90	2 50	1 66
Norfolk & Western	2,085	4 20	56 16	2 35	1 56
Virginian Ry	505	3 40	53 02	1 77	1 18
Carolina, Clinchfield & Ohio	283	5 82	49 80	2 90	1 98
Chicago & Alton	1,052	6 18	71 07	4 39	2 92

These very low cost figures of hauling bulk freight over railways with low grades and heavy traffic are based, it will be seen, on official records. They cannot be denied or explained away. Nor is there any reason to doubt their accuracy. A modern railway freight train enables a crew of six to eight men to transport a load of 3000 tons or more at a speed of 10 to 20 miles per hour. It is easy to see how small are the cost of labor and coal and all other expenses of conducting traffic compared with the great number of ton-miles of transportation accomplished per hour or per day.

Expenses of Barge Transport and Rail Transport Compared

We must accept, then, the figures of 1.60 to 2 mills per ton-mile as a fair average of the operating expenses in transporting low-grade bulk freights on railways of easy grades and heavy traffic. Can any inland water carrier transport bulk freights at lower cost than this? It cannot be done by the river steamboat. A glance at its payroll in comparison with its cost per ton and its load capacity shows this to be certain. Nowhere in the world, even in Europe, are low-grade bulk freights handled by river steamboats in any quantity.

The only type of vessel which can handle bulk freights on inland waters at low cost is the barge, moved in fleets by a single power boat. There are, however, no official statistics of the cost of barge transportation which can be compared with the preceding figures for the cost of haulage by rail. We must, therefore, resort to comparison of the various items that make up the total cost.

In waterway promotion literature, great emphasis is laid on the small resistance to motion of a barge floating in water compared with a car rolling on a track. This difference, however, is much less than is generally asserted, and has no such controlling influence. The cost of the power used in hauling by either water or rail is a small fraction of the total cost.

The cost of barge construction per ton capacity is somewhat less than the cost of railway cars; under price conditions prevailing before the war, cars for bulk freight cost $25 to $40 per ton, and barges for inland waters cost $10 to $25 per ton. The annual maintenance cost of the barge probably equals that of the car, and its depreciation is at least as great. The largest item in the operating expenses by either water or rail is labor. The crew for a fleet of barges on inland waters carrying a total load equal to a freight train on a heavy-traffic road will probably equal the train crew in number, but its hourly wage rate has been much lower.

On the other hand, the barge fleet on inland waters can make only 1½ to 3 miles per hour, while the railway freight train averages 10 miles. Of course it is true—and waterway advocates make a great point of this—that railway cars stand still a good share of the time. But, after allowance is made for this, the railway car and the railway freight trainman will make an annual average mileage two to four times as great as the river barge and its crew. Thus, the annual expense for interest, depreciation, wages, etc., on freight trains is distributed over a greater number of miles.

Finally, in any comparison of actual freight-rate charges by water carriers with rail rates, the advantage of the boat in having no expense for its roadway must be borne in mind. Fully 20% of railway operating expenses are assignable to maintenance of way; so if the barge carries freight at 80% of the railway rate it will have no lower total cost for haulage than the cost by rail, even when the cost of the waterway on which the boat operates and which the taxpayers build and maintain, amounts to no more than one-fourth the rate charged by the barge.

It is true that the figures for cost of railway transport which have been given above are for the year 1916 (the last for which the official statistics are available), and that since then a great advance has taken place in expenses. This does not materially affect the above comparisons, however, for the advances in labor, in fuel and all other materials have hit the water carrier harder than the railways. It is only the water carriers on the ocean, where railway competition is absent, that have prospered during the past four years.

No more detailed comparison than the above is necessary to prove that the common assumption that water transport is cheaper than rail transport is not justified. Where the conditions are most favorable for water transport, the difference between the two is so small that, to settle the question in a particular case, a careful estimate, which will take into account local conditions, must be made. Further than this, the very low cost of rail haulage above determined proves that even where barges are operated under most favorable conditions their saving over rail rates cannot be large. Where freight can be hauled by rail for 1.75 mills per ton mile, the utmost possible saving by substituting water transport can hardly exceed a mill per ton-mile, or 10c. for a distance of 100 miles.

But wherever population and traffic are dense enough to support a waterway in competition with a railway, terminal expenses are bound to be very large compared with the cost of haulage. Whether the waterway or the railway will be the cheaper carrier, therefore, will depend on the relative terminal expenses.

Terminal Expenses Have Become Controlling

In order to get a correct view of the comparative merits of railway and water transport, the fact must be grasped that the terminal expenses have become today the chief factor in transportation cost everywhere save in very long distance shipments. The application of steam power to transportation has annihilated distance both on water and land. The mere loading or unloading to or from a car or boat by hand labor usually costs 30 to 50c. per ton, and haulage by trucks to or from the wharf or the railway station may cost 30c. to $1 or more per mile. These are the operating expenses alone. To them must be added the interest, depreciation and maintenance charges on the terminals and cargo-handling machinery. Either the railway or the waterway can usually haul the goods, when once loaded, at so low a figure that the difference in cost between the two methods of transport will usually be much less than the difference in terminal expenses.

Within recent years this fact has been to some extent grasped by the promoters of waterways, and it is common to hear it emphasized that "good terminals are as necessary to the success of water transport as good channels." But the question to be settled in any given case where water transport is under consideration is whether the total cost of transport, *including the charges on the necessary investment in channels and terminals*, will be less than the cost of rail transport, where the charges on the railway line and its terminals are necessarily included.

The Railway's Advantage in Terminals

It is obvious that only a very small proportion of the country's traffic originates on or near a navigable stream, or is delivered there. The railway, on the other hand, reaches every community of any size. In every important manufacturing or industrial plant (save those in a few very large cities, such as Boston, New York and San Francisco), railway spurs run directly into the works. A car once loaded with goods can travel across the continent, traversing perhaps a dozen different railway lines, until it reaches its destination. Breaking bulk en route to transfer from rail to water or vice versa is very costly, and involves, besides the direct cost of handling the freight, more or less delay and risk of loss by theft or damage.

It is in the cost of transfer from the railway to the waterway and back again that the greatest obstacle to extensive use of inland waterways is found. With even the most generous estimate of the saving per mile of water transport over rail transport, the cost of transferring freight between the railway car and the steamboat twice on the journey will offset the saving by use of the water route over a considerable distance, especially as it is on long-distance shipments that the railway can afford to make the lowest rates.

If this dominating fact is comprehended—that the cost of breaking bulk and of terminal handling is the big item in transportation costs today, while the cost of the actual transport per mile, by either rail or water, has sunk to an exceedingly small amount—it is then easy to understand why the field in which the waterway can compete with the railway is closely limited.

Here also is to be found one of the main reasons why inland water transportation in Europe has an importance that it has never attained here. Europe's cities and many of its industries were established long before the railway era, when the only cheap inland transportation was by water routes. Water transportation has been maintained in Europe because there was a large volume of business which could be handled from origin to destination without the use of the railway at all.

In the United States most cities and most industries have been built up with sole regard to the use of the railway. The inland waterways of the United States in many respects offer facilities for navigation far superior to the waterways of Europe; but few industries are located on such waterways.

Except at the seaboard, a waterside location for an industrial plant is generally inferior to a location inland. Foundation and drainage difficulties at a waterside location are apt to be such as to add materially to the cost of construction. A wharf or pier for water transport will usually cost several times as much as a railway spur track. More important still, in an industrial plant of large size, covering often a large area of ground, the railway tracks can be run directly into the warehouses or shops, thus saving largely in the transportation cost inside the works.

Especially is the waterside location unfavorable where a waterway is subject to great changes of level. Such changes exist on practically all natural waterways; on those connected with the ocean because of the tides, and on rivers because of alternate floods and droughts. The Ohio and Mississippi rivers, which are the most important inland navigable rivers of the country, have a variation of 20 to 70 ft. between high and low water at various points. As they flow for most of the distance through a broad alluvial valley, where good foundations are often very difficult and expensive, and where changes in the channel are frequent, the building of structures capable of handling river freight traffic economically is very costly and is attended with much risk of loss. Such works can only be profitable if a very large volume of freight is handled over them.

These facts are sufficient, probably, to explain why industrial plants in the Ohio valley are only located close to the river where topographical conditions compel such a location. The disastrous floods within the past dozen years have brought into special prominence the advantages of upland sites for industrial plants compared with sites on the flood plain of a river.

Handicaps of Water Transportation

Any comparison of the ability of water transport lines to compete with the railway must not omit the inherent defects of the waterway as compared with the railway. Modern commerce has become adjusted to the regularity and reliability of railway service and takes it as a matter of course. By no art of the engineer can water-borne traffic be carried with equal safety and certainty, especially on inland rivers. The steamboat is subject to delay by fog, by low water and by flood; there is, besides, risk of accident several times

as great as the risk on goods sent by rail. The railway is responsible to the shipper for the value of his goods, and its fixed property is a guarantee that this responsibility will not be evaded. The responsibility of the water carrier is in most cases an uncertain quantity. In order to be protected in the transport of goods, the shipper must go to the trouble of obtaining marine insurance to cover them.

Those who have sought to rehabilitate water transportation have generally overlooked the necessity that responsible concerns must engage in the steamboat business, or no great volume of traffic will go by water. New York placed on its statute book years ago a law limiting the capitalization of any concern engaging in traffic on the state canals. The framers of the law saw no further ahead than that the business must be kept open to free competition among the canal-boat captains, owning each a few barges and running them in the old-time way. To allow the canal traffic to be handled by large companies would result in combinations among them and with the railways to limit competition.

Such reasoning ignores the changed commercial conditions of the present day. It is no more possible for the old-time canal boat captain to be a serious competitor of the railway for freight business than it would be for the old-time stage coach to compete for passengers.

XI—Railway Competition, Past and Future

It will be evident from the facts cited in the previous chapter that the water carrier could very seldom compete with the rail carrier if, like the rail carrier, he had to bear the cost of the road which he uses. The cost of making and maintaining the waterways and even the cost of terminals, however, has been borne by the taxpayers. All the water carrier has to invest in is a boat. Under these conditions, what chance has the water carrier of competing successfully for business?

There is no doubt that the waterway advocates are correct in their assertion that if the railway is permitted freely to compete with the inland waterway, it will be impossible to reëstablish inland water transportation on any large scale. The railway can reduce its rates below cost if necessary to meet a boat's competition and can raise them again after the boat has been taken off. The railway need not necessarily lower its rates to do this. If a line of boats begins operating on a river, the railway can start a competing boat line and lose money on it, if necessary, long enough to put the other line of boats out of business.

Such things have been done in the past. They are less likely to be done today, because of the different public sentiment toward unfair methods of competition, because of legislation restricting the railways from controlling water lines, and because water competition is today too insignificant to make it important for railways to make great effort to oppose it. Nevertheless, the railways, if they are operated by competent managers, are certain to go after the business and take it away from the waterway, if it is worth taking.

Nor are the railway managers to be blamed for this. The law still recognizes competition as a factor in the railway business. It expects the railways to compete with one another and with other rival concerns, and even threatens them with pains and penalties if they attempt to avoid competition. Whether the railways are operated by private companies or by the Government, it is the duty of the railway managers to operate them as efficiently as possible. The well known rule of railway business is, "It is additional traffic that pays dividends." To permit traffic to be diverted from a railway means that the fixed charges for operating and maintenance will have to be borne by a smaller volume of business. The managers of railways, therefore, in endeavoring to prevent the diversion of business to waterways, are merely doing their duty toward the property for which they are responsible.

Rail Rates Lowered by Waterway Competition

Probably the greatest single influence in convincing the public that water transportation is cheaper than rail transportation is the long-established practice of making rail rates to points where water competition exists lower than to inland points. These rates date back to the time when the battle between the railway and the steamboat was active and bitter. The whole railway rate structure, in fact, is based on the competitive conditions which prevailed half a century ago, and survives after those conditions have ended.

The Interstate Commerce act of 1887 recognized this condition as one too firmly established in the country's business to be uprooted, and the Commission was expressly authorized to grant exceptions to the famous "long-and-short-haul" clause of the act. Under the authority of the Commission the railways have ever since continued to make freight rates to seacoast points and points on interior navigable rivers lower than to inland points.

There has now been before Congress for a year a bill to amend the Interstate Commerce law by making the long-and-short-haul clause absolute and taking away the authority of the Commission to grant exceptions to its operation. If this bill becomes a law, the power of the railways to make lower rates to meet water competition will be eliminated.

In the committee hearings on this bill in the last Congress the only opposition to the bill by any railway company was that offered by the Southern Pacific Co., probably because of its special location with respect to the Panama Canal. The fact that no more opposition came from the railways is an excellent illustration of the change in attitude of present-day railway managers toward water transport lines. The majority of them recognize, without doubt, that the present rate structure is filled with discriminations such as this which have long outlived the conditions under which they originated. Many of them are aware that the day when the river and canal could offer serious competition to the railway has passed.

Director General Hines, in a statement published April 10, 1919, declared that the Railroad Administration's policy was that water and rail competitive rates should be proportioned to the relative cost and desirability of the respective routes. In a case now before the Interstate Commerce Commission involving the discontinuance of the special rates made to Mississippi River points on account of water competition, the Railroad Administration has not opposed an order placing rates to river and interior points on a parity.

In the committee report on the above-mentioned bill to repeal exceptions to the long-and-short-haul clause of

the Interstate Commerce law, General Charles Keller, of the Corps of Engineers, head of the Board of Engineers on Inland Waterways, testified, "No really successful river navigation can be established unless the present structure of rail rates is completely revised so as to take away from river communities the unjustly favorable rail rates that now exist."

Director General McAdoo in his official report at the close of his administration said, "I doubt if any of our rivers or canals will become active factors of transportation if the railroads are turned back to private control. The old methods of railway competition with the waterways doubtless would be revived."

Cities Oppose Removal of Discrimination

It is not the railway companies which are the chief obstacle to the removal of the present rate discrimination in favor of the river and coast cities, but these cities themselves, and to a large extent the entire commercial community. Director General Hines well summed up the situation in his letter of April 10, 1919, when he said, "Whether the existing rate structure is altogether sound or not, the commercial and manufacturing interests have largely adjusted themselves to it, so that any general radical change of rate relationships would be exceedingly disturbing to business interests and to many communities."

Were the railways back under private control and were any such radical change undertaken as the elimination of the long-standing discrimination in favor of water competitive points, an outcry would go up that would compel public authorities to interfere and prevent the change.

In hearings before the Congressional committee which has in charge the pending bill to enforce the long-and-short-haul clause, there appeared in opposition on June 10, 1919, representatives of the Chicago Association of Commerce, the National Industrial Traffic League and the New York Merchants' Association. This is typical of the opposition that will have to be met and overcome before the bill can become law. The opposition to eliminating this long-standing discrimination, established originally in order to enable the railways more effectively to compete with the water routes, comes not from the railway managers but from the great commercial centers which have long been the beneficiaries of that discrimination.

The railways, if they are to be turned back to their private owners, face the absolute necessity of raising their rates if they are to remain solvent. It is to their interest that the necessary increase of revenue should be secured by raising rates to points which are now too low in proportion to the general rate level, rather than by a general increase to all sections.

The commercial organizations of the country have for years been active in the campaign for waterways. They have looked forward to the completion of these waterways and the establishment of traffic upon them. But the very advocates of these waterways declare there can be no traffic upon them unless the special railway rates established to meet their competition are eliminated, and these same commercial organizations are now fighting to retain these special rates.

By way of direct illustration, the Merchants' Association of New York City was a principal factor in the campaign twenty years ago to secure the construction of the New York Barge Canal. In the hearing on the pending long-and-short-haul bill before Congress, General Keller, of the Corps of Engineers, said, "We have looked into the possibility of putting to advantageous use the New York State Barge Canal. The condition there is much the same as in the Central Valleys. On the present basis of railroad rates, business cannot profitably be done by the canal."

Yet the Merchants' Association now fights the revision of railway rates without which the waterway, for which it is partly responsible, will remain unused!

One of the demands most insisted on by the waterway advocates is that the railways should be compelled to establish joint rates with water carriers, and it is alleged that the failure of the railways to make such rates is one of the methods they have used to drive the water carriers out of business. It is obvious, however, that the railways can only make joint rates with water carriers who are financially responsible and who will quote rates which will have some stability. As one step toward this, a bill now pending in Congress proposes to place water carriers under control of the Interstate Commerce Commission, and compel them to file published rates as do the railways.

This proposition has met the well nigh unanimous opposition of the water advocates. They urge that the boats cannot stand the burden of expense involved in filing and adhering to a regular rate and that they must be free to change their rates from day to day as they please. That the railways cannot quote joint rates with water carriers so operated and that shippers who entrusted freight to such irresponsible carriers would run risk of heavy losses is too obvious to require proof.

Lack of facilities for transfer between the railway and the waterway is, of course, a further obstacle to the making of joint rates. Who is to pay for such facilities? As has been already fully demonstrated, the cost of the transfer, even with such facilities provided, will generally exceed any saving made by using the water route. Certainly the railway cannot be expected to join in providing such facilities unless the water carrier which is to use them is a responsible concern likely to stay in the business and to handle sufficient traffic at stable rates to make the investment an attractive one.

In other words, if the water carrier is really to be an important competitor of the railway and be "coördinated" with it, its business must be as stable and reliable as that of the railway. Attempts to revive water transportation on the archaic lines of a generation ago are sure to fail.

(To Be Continued.)

New Water Tank for Akron, Ohio

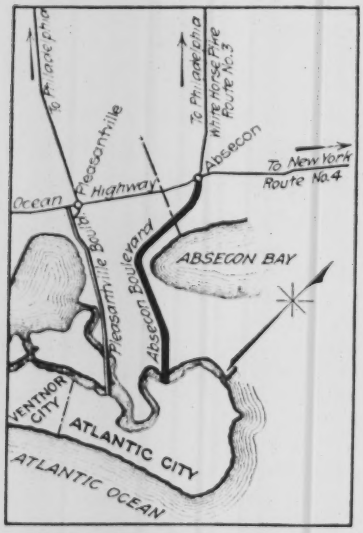
Three types of water-tank construction were submitted for bids recently by the Bureau of Water-Works Improvement at Akron, Ohio, the tank to have a capacity of 150,000 gal. These types were as follows: Monolithic reinforced-concrete tank and tower; steel tank and tower; elevated steel tank inclosed in concrete tower. No bids were offered on either type of concrete construction. As the tank is to be located in a residence district, it was intended to provide a structure of better appearance than the ordinary steel tank and tower, but on account of the advanced season and the need of improved service in the district it was decided to construct a steel tank which may later be inclosed in a masonry shell. G. Dale Dixon is chief engineer.

Hydraulic-Fill Highway Across Salt Marsh

Hydraulic Dredges Throw Up Embankment Between Retaining Walls of Salt Meadow Sod

HYDRAULIC dredges have recently completed nearly 250,000 yd. of embankment for the new road connecting Atlantic City, N. J., with the state highway system on the mainland. A 12-in. and a 16-in. dredge were used, as, owing to war conditions, these were the only machines which could be obtained, and both were too small to be economical for the volume of work to be performed.

Material for the fill is largely fine sand, and was pumped from the bottom of Absecon Bay. The approximate length of the longest discharge was about one mile. To hold the fill, which was 5 to 6 ft. high in places, walls of salt meadow sod were built along each of the edges as the filling progressed. These walls stand on a surprisingly steep slope of about 1 horizontal to 4 vertical. The sod walls held the fill admirably. About 247,236 cu.yd. were placed at a cost of about 30c. per cubic yard. This fill is surfaced with 106,546 sq.yd. of gravel 8 in. thick which cost 40c. per sq.yd. The clear roadway between guard rails is 40 ft., and the crown is a parabolic curve with a slope of $\frac{3}{4}$ in. per ft. The total contract price for this work was $280,321, as let on March 10, 1916. It has been carried on by A. H. Nelson, engineer for Atlantic County. W. G. Thompson, state highway engineer, has had general supervision for the state, which contributed substantially towards the construction.



NEW HIGHWAY CONNECTION WITH ATLANTIC CITY, N. J.

Hours of Labor and Wages in England

According to information from the office of the American Consul General at London, the British Ministry of Labor reports that wage increases effected during November, 1919, and applying to 1,900,000 people, represented a weekly increase of £480,000 ($2,335,900 at normal exchange), or about £25,000,000 annually. During the first eleven months of 1919, 5,250,000 workers secured increases aggregating not far short of £2,000,000 weekly, or practically £100,000,000 ($486,650,000) per annum. Seventeen groups of trades were represented in that increase. During November, 30,000 work people had their hours of labor reduced on an average of three hours each, or 90,000 hours for the month. Changes effected in this respect during the first eleven months of 1919 aggregate 36,211,000 fewer working hours, the number of working people affected being 5,479,000.

Impressions Here and There

Highway Work in Texas

TEXAS counties authorized a grand total of some $80,000,000 of bonds for highway improvements during the year 1919 by popular vote, but a constitutional amendment that would have authorized the legislature to provide for the issuance of $75,000,000 state highway bonds was defeated.

A pre-election canvass of engineering opinion in a number of Texas cities, combined with a careful reading of the daily press, showed considerable doubt as to the bonds carrying. In fact, their failure was confidently predicted by some. There were three main grounds for this prediction: (1) That the voters of Texas had acquired the habit of voting down constitutional amendments generally; (2) that the state aid being particularly needed by the poorer and more sparsely settled counties was a reason why the more prosperous and popular counties would vote against the proposition; (3) that the proposed constitutional amendment gave blanket authorization to the legislature to handle the proposed bond issue as it saw fit without throwing any safeguards around the expenditure of the money.

As to the first of these grounds, the election itself seemed to support the reasoning since of a half dozen amendments submitted at the same time all were defeated except two, one of these permitting an increase in the allowance to Confederate veterans of the Civil War by a cent or two a day, and the other simply authorizing Galveston County to vote on issuing more flood-protection bonds. Little evidence is available to show to what extent the adverse vote on highway bonds was influenced by a feeling of the more prosperous sections of the state that they did not want to contribute toward road improvement in the poorer districts, but it seems more likely that the chronic Texas objection to constitutional amendments and the distrust of the state legislature were the strongest factors in defeating the constitutional amendment in question.

It is worth noting that the legislative rather than the administrative branch of the State government seems to be held in question so far as this constitutional amendment and the powers it would bestow are concerned. A Forth Worth engineer long resident in Texas stated after the election that had he been at home he would have voted against the amendment because there was no safeguard provided for the expenditure of the money. He added that he would have voted yes could he have been assured that the present chief engineer of the State Highway Commission and the members of the Commission itself would be retained in office to expend the $75,000,000. It is significant that nowhere was criticism of the State Highway Commission heard and that as to the state highway engineer there was a great unanimity of engineering opinion favorable to the way he is conducting the affairs of his office. An engineer in Houston, while not criticising the State Highway Commission, did express himself strongly to the effect that it would be better if one of the members of the Commission were an engineer.

This same engineer, in talking of the carrying on of road work for counties, remarked that county organization in Texas is not conducive to good road engineering—either as regards the way the commissioners are selected or the resulting caliber of men. These courts of commissioners, as they are called in Texas, consist of five members. Four are elected by popular vote and the fifth is the county judge, who presides and casts the tie vote. These commissioners have large powers, but the viewpoint of some of them is illustrated, this engineer stated, by what happened in a county that voted $2,000,000 of road bonds. The commissioners did choose a good engineer but gave him a room in the basement of the court house, provided him with a table instead of a desk, and "could not see why he wanted a lot of instruments."

An engineer in Austin remarked that even in those counties of large population, where a majority of the voters are residents of cities, men of large caliber are seldom appointed as commissioners. Still another engineer, commenting on how the counties go at their road work wrong, spoke of a county where the people—presumably on the recommendation of the court of commissioners—voted $1,000,000 for temporary road improvement and $100,000 for permanent improvement, when, in his opinion, the sums should have been reversed.

Rollin J. Windrow, state highway engineer of Texas, stated that the county road bonds voted in Texas in 1919 were based on pre-war prices and that the promoters of these roads promised more mileage than the bonds will build. He added that some of the counties are bonded to the limit and that in some cases there is a strong desire to cheapen the work so the bonds will go further. He is taking the firm stand, in connection with such projects as come before him for approval, that he will not compromise on location, grade or drainage, but that the counties may in some cases be allowed to ease up for the present on surfacing.

In a pre-election statement Mr. Windrow said, in advocacy of the bond issues: "There is scarcely a county system which has been voted or is proposed in the State that is not under-financed. These counties come to the State Highway Department seeking aid, but except for the Federal funds this department is practically helpless. With the funds provided by the counties, some portion of road construction must be sacrificed. If the department had sufficient money to substantially aid counties, then it could demand a reduction of mileage and such an improved type of road that would give a permanent investment and permanent service over such roads as are built."

A few weeks after the election the State Highway Commission gave out a summary showing that $18,677,480 were available from state and Federal sources for road construction in Texas, $16,215,285 being Federal and only $2,462,195 being state-aid funds. With the small amount last stated, the Highway Department of Texas must do the best it can to supplement the deficiency in county appropriations. Since in some of the larger and more prosperous counties the bond issues run up to $5,000,000 or $6,000,000 it is evident that very little can be done in many other of the counties without extensive state aid if the Federal-aid appropriation is to be fully utilized.

More exact figures than have yet been cited as to county bond issues have been made available by Capt. J. D. Fauntleroy, district engineer in charge of Federal aid in Texas, Oklahoma, Arkansas and Louisiana. From Jan. 1 to Nov. 1, 1919, Texas counties voted a total of nearly $78,000,000 road bonds and there were then an additional $14,000,000 to be voted on before the close of the year. About 110 of the 257 counties in Texas were included in the $78,000,000 of road bonds named. The counties that had not voted highway bonds up to Nov. 1 were mostly in the Panhandle and in southwest Texas.

Inquiries in a number of cities disclosed a shortage of available road materials, besides great difficulties in getting them moved. State highway Engineer Windrow has a special division engaged in locating highway materials.

The foregoing notes, based on information gathered while visiting a half dozen cities in Texas, will serve to illustrate some of the road problems confronting state and county highway officials, engineers and contractors in that State. The people at large do not seem to appreciate the relative poorness of their county organization and the relative goodness of their state organization for road construction. They have voted large and small bond issues in more than 100 counties and have defeated the amendment authorizing extensive state aid.

It may be that had a comprehensive state highway improvement plan been worked out in Texas, and laid before the people for approval in connection with the constitutional amendment, the latter would have carried. Such a plan need not have been incorporated in the constitutional amendment, where it would, of course, have been out of place. The constitutional amendment might have merely authorized the legislature to issue bonds to the extent of $75,000,000, or any other sum named or unnamed, provided that a comprehensive plan for the improvement of the highways of the state should be worked out by the State Highway Commission and submitted to the voters for their approval in connection with a proposed bond issue.

Dec. 15, 1919. AUSTIN, TEXAS.

Railway Bridge Inspections and Records

Frequent bridge inspection is a highly important factor in the conservation of material which is now so important, as such inspection tends to insure both safety and full service from each structure. This is one of the conclusions of a report on railway-bridge inspection which was presented at the annual meeting of the American Railway Bridge and Building Association held recently at Cleveland, Ohio. Systematic and thorough inspection should be made, therefore, on every railway, at intervals of not more than 12 months and preferably every six months. Motor cars are recommended for inspection trips, as the use of regular or special trains involves too much loss of time.

Forms for field records of inspection should be complete, comprehensive and convenient, but although numerous forms were received by the committee it has found none that it can recommend for general adoption. Separate reports should be made for steel and timber structures. By making these field reports in manifold, much copying and office time may be saved. As it is difficult for the inspector to do his work and make his notes at the same time, he should be accompanied by such assistants as may be necessary to effect a rigid inspection. The inspector should record his recommendations as to repairs and renewals at the time when he makes the inspection, and should have authority to order immediate repairs where necessary.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Engineering and Adventure

Sir—"Incog," whose letter to the editor was published in your issue of Jan. 8, p. 98, likes Professor McDonald's paper, "Engineering and Adventure." That is perhaps of little importance. I do not like "Incog's" communication. That is, perhaps, of not much importance, but I want to say why I don't like it and possibly that may be of some interest to some reader, though not of great importance.

I don't like it because it breathes the spirit of warfare in business. He says, "We set out to get the scalp of the older organization." It seems to me that it makes no difference that the scalp was to be raised by doing a better job or giving a product more nearly meeting the demands of the field. They were after the scalp—that is the important point.

It would seem to be, at least, possible that the spirit of the whole concern was wrong and that this was responsible for what appeared to be the failure of a part of its personnel.

It seems to me that there is a fine text here for a good sermon which shall be a preachment on the ethics of business.

Inasmuch as the critic does not know who is being criticized, it is perhaps well that the criticized shall not know the critic. Therefore permit me to subscribe myself. INCOG. No. 2.

Sir—The letter by "Incog" in the issue of Jan. 8, p. 98, is interesting for its frankness, which is a quality that lends as much zest to life as does adventure. It is true that individualistic men who lack a sense of proportion catch the disease which W. L. Saunders diagnosed in engineers as megalomania—in other words, "swelled head." But individualism means properly that the individual develops also the power of self-criticism. The most successful men are naturally conceited, but they have learned to control what then appears to be only a commendable self-confidence, and they understand how to direct other men's conceits. Is it not better to develop men able to critize themselves than to deaden spontaneity and discourage the expression of natural talents? P. B. MCDONALD,

Assistant Professor of English.

New York University.

Dividing a Trapezoid Into Strips of Equal Area

Sir—The article of P. Arneson, on "Pile Foundations for Unequal Load Distribution" (*Engineernig News-Record*, Oct. 9, 1919, p. 698), suggests to me that simple formulas for dividing a trapezoid into any number of equal parts may be worth mention. Their general form, and the manner of using, will be apparent from the following example:

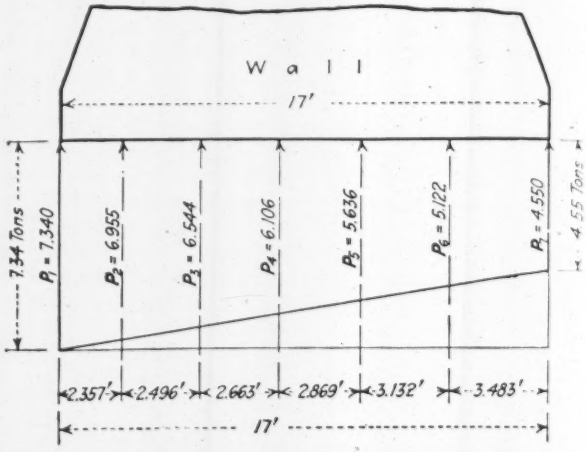
Take the pressure trapezoid represented in Mr. Arneson's article, 17 ft. wide, with a unit pressure $P_1 = 7.34$ tons on one side and $P_7 = 4.55$ tons on the other, having an area of 101.065 units. This trapezoid of equal size, each to contain 16.844 units. The unknown sides of the small trapezoids are represented by P_2, P_3, P_4, P_5 and P_6 in the accompanying diagram. Then

$$P_2 = \sqrt{\frac{5P_1^2 + P_7^2}{6}}; \quad P_3 = \sqrt{\frac{4P_1^2 + 2P_7^2}{6}};$$

$$P_4 = \sqrt{\frac{3P_1^2 + 3P_7^2}{6}}; \quad P_5 = \sqrt{\frac{2P_1^2 + 4P_7^2}{6}};$$

$$P_6 = \sqrt{\frac{P_1^2 + 5P_7^2}{6}}$$

Substituting the values of P_1^2 and P_7^2, we get $P_2 = 6.955$, $P_3 = 6.544$, $P_4 = 6.106$, $P_5 = 5.636$, and $P_6 = 5.122$ tons. With both sides and the area of each



trapezoid of equal size, each to contain 16.844 units. This method combines simplicity with absolute accuracy, and requires no knowledge of mathematics other than arithmetic. R. B. MCWHORTER,

Ass't. Division Engineer, Miami Conservancy District.

Hamilton, Ohio.

Theory and Practical Rules in Detailing Building Steelwork

Sir—The letters in your issue of Nov. 27-Dec. 24, 1919, p. 961, and Jan. 8, 1920, p. 99, by Leonard C. Jordan, George Paaswell, C. L. Carman and W. M. Wilson, criticising my article on "Common Errors in Detailing Steelwork for Buildings" (Oct. 16, 1919, p. 730), gave opportunity for discussing a phase of engineering designing that, in my judgment, is of vital importance. These gentlemen have brought up some subjects upon which I have very strong convictions, based on experience of more than a quarter of a century of examination of plans and structure that are the work of other designers; and I should like in a future article to take up some space with what I believe to be constructive criticism of engineering education.

For the present I wish to define "practical designer" and "ultratheorist" as I have used the terms. By practical designer I do not mean the man who ignores theory and designs by guess and the rule of thumb; I refer simply to the class of men who are doing the practical designing, men who make it their business to design. In this class there are a few men who are up in all the intricacies of theory, but the average designer, while he understands the basic theories of design can

follow the theorist so far, and then he loses the way. Rules of design for him must be predigested. If fine-spun theory is encountered in the way to the solution to a problem, he sidesteps it; and very frequently in his design, he simply ignores things that are of vital importance, because he sees the theoretical lion in the way. For this reason there is often a great hiatus in the work of the practical designer. It is to help this class to do better work that I am striving to induce the engineering profession to simplify their theory so as to eliminate superfluous matter, the presence or absence of which has no bearing whatever on the safety or economy of structures, unless it be that it adds greatly to engineering cost in the design.

The ultratheorist is the man who plays on an instrument with one theoretical string, and that is the perfect elasticity of steel. If the ultratheorist were inclined to take all facts and theories into his problem and weigh their relative merits, he would perhaps discard some of his intricate theories; for the solution of some problems, if every fact were considered, is so stupendous that the thing would fall from sheer weight. As an example of an ultratheorist, a certain author takes up pages of his book, in a most complex theory of earth pressures, to work out a retaining-wall formula on an assumption of properties that no earth on this planet possesses.

Horse sense is theory in oilskins and rubber boots. It is as much theory as the elasticity of steel. But it is the fag ends of theory that do not admit of nice mathematical solution. It is just as much a scientific fact that steel is tough as that steel is elastic. But the toughness of steel, while it saves the life of countless structures and men, is erratic and not subject to nice laws, such as an assumption of perfect elasticity. Hence, the ultratheorist prefers to work out his problem on the perfectly elastic theory.

To answer specifically some of the criticisms of my article: The statement that a condition of eccentric loading was repeated on all floors was not made to convey the idea that repetition produces greater stress on a column, but only that the error was multiplied and that the repetition ought to have called the designer's attention to it.

As to designing beams for distance between seats or connections and proportioning the columns for the bending moments, designers would be willing to take the license to shorten the spans of beams, but *they will not design columns for the resulting bending moments.* They do not do it where heavy loads are plainly eccentric either in steel or concrete designing. It is easy to enforce the rule for span length but a practical impossibility to introduce anything so fancy as bending moments on columns for usual or even unusual loading.

In Mr. Carman's Fig. 1 he runs the web of a girder through the column and claims that this could be figured as central loading, producing no moment on the column. This is an impractical detail, and it reduces the column section by cutting off the web. It is far from being as good as my detail Fig. 1 (a), for in this latter the rivet heads will easily take the tension due to the small calculated bending moment in the "girder" at the face of the column.

Mr. Carman will find that I recommended the method indicated in his Fig. 3. The approximate method was given to impress designers with the fact that an eccentric connection needs far more rivets than barely enough to take the end shear of the beam, and in the hope that some designers would adopt it as a rough and easy way to make an ample connection for an unusual case. As a rule such cases are not frequent, and a little extra metal will be found negligible.

Pittsburgh, Pa. EDWARD GODFREY.

Troubles With Blue Clay

Sir—The article on p. 989 of *Engineering News-Record*, Dec. 11-18, 1919, is of special interest as the large sewer referred to is yet to pass under twelve Michigan Central tracks, five of which are on a fill. The disturbance of substrata referred to in the article occurred but a short distance from the first of the tracks. I note that the writer of the excellent article states that the "blue clay" is chemically something else, but I am not sure that he defines it.

During the past summer four piers were put down to bedrock in Detroit for the Michigan Central. The Missouri Valley Bridge & Iron Co. did the work, using compressed air. The location was 2½ miles from the site of the sewer-construction troubles and the same "blue clay" was encountered down to hardpan, or about 10 ft. above bedrock. In one pier a hydrogen-sulphide gas gave considerable worry when the pier was almost landed on rock. This same thing occurred recently on a "free air" job at Chippawa on the project described on p. 1010 of the same issue of *Engineering News-Record* previously referred to. This canal passes under the Michigan Central at three points.

Another matter, largely of local interest, is the attempt made at the Ford blast furnace here last summer to put down a 6-ft. pier to rock by the Chicago method. The location is not far from the sewer job and the Michigan Central pier job, and I understand considerable trouble developed.

Detroit. L. B. ALEXANDER,
Assistant Bridge Engineer, Michigan Central R.R.

A Full Day's Work—Industry's Need

Sir—The writer respectfully submits a few thoughts in reply to the article on p. 813 of the *Engineering News-Record*, issue of Oct. 30-Nov. 7, entitled: "Construction Labor's Instability," in which W. P. Schmuck appeals to Congress to enact legislation permitting a greater influx of immigrants, in order to secure a sufficient supply of common labor.

It has been my observation that what we most need just now is an increased output by the labor we have with us. On several large road contracts in this territory, common labor is receiving practically double the wage of 1914, and is producing, or turning out, about 60 per cent as much as in 1914, making the results cost the contractors, not 100 per cent increase, but at least 150 per cent increase for the portion of his costs represented by labor, as compared with the condition that obtained in 1914. The work day here was a full 10 hours, until our Government took over certain local industries, for the duration of the war. The Government shortened the work day to eight hours, used three men on an average to do what two had been accustomed to do, and the results—we have with us now. Labor is surly, indifferent, quits for no apparent reason, works

not more than three-fourths of the time, and produces as little as possible when working.

A sane campaign conducted by employers, aided by the daily newspapers, and other publications, calling on every true man to buckle down to business, render a full day's work each day, and not less than five and one-half days per week, would get us started on the right road once again. Employers take too little interest in their employees. Better talk with them at the noon hour, use one-half an hour each week, at the employer's expense if necessary, to give them a little friendly talk. Make them feel human, and let them know you are human, and reward industry, but stamp out indolence, and get their help in doing it. Now is the time to begin this kind of work.

I for one object to an influx of foreigners, and am heartily in favor of sending back many we now have with us. We do not need I.W.W.'s, Soviets or Anarchists, and should we let down the bars, we are sure to regret it bitterly later on.

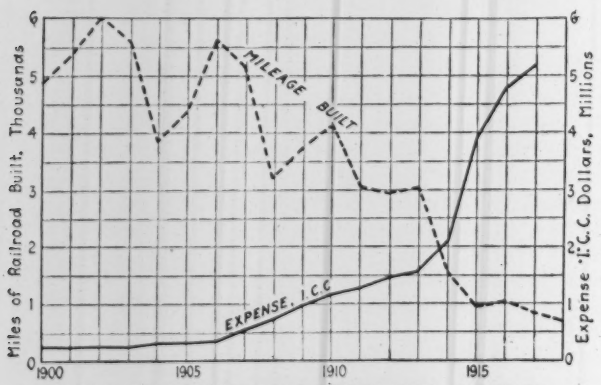
Machinery is fast showing the way to increased results, with less men, less effort, and a better job. Intensified labor is all we need, and inducing labor to see it that way will get the results. Your effort lies in securing labor's co-operation to that end.

F. S. PARRIGIN,
Panama City, Florida. Civil Engineer.

Railroad Regulation and New Mileage

Sir—I have prepared the accompanying diagram from official figures showing the cost in recent years of regulating American railroads through the National regulating body only (the Interstate Commerce Commission) and the mileage of new railroad built in the same years. This diagram shows pretty clearly, as I see it, that the more you "regulate" the more you check growth.

The diagram is, to my mind, self-explanatory, but I may call attention to the right- and left-hand ends



COST OF REGULATION INCREASES AS NEW MILEAGE DECREASES

of it. In 1900, when a quarter of a million dollars was spent regulating, the mileage built was 4,894 miles; in 1917, when 5 millions was spent for same purpose (regulating), the mileage built was 870. And between these points, while there are ups and downs, the general and unmistakable tendency is that at the slope of the "regulating" graph becomes steeper (rises), the slope of the "building" graph becomes more pronounced (falls).

The "moral" to be drawn from this diagram, which is meant to be critical, is this: Do not handcuff the workman or servant whom you wish to do heavy work for you; he can do more if you leave his hands free.

Nashville, Tenn. JOHN WILKES.

Rigid Connections in Building Steelwork

Sir—Professor Wilson's letter, in your issue of Jan. 8, commenting upon Edward Godfrey's article on "Common Errors in Detailing Steelwork for Buildings," very properly points out that the rigid connection of girders to columns has the effect of increasing the bending stress in the columns over that induced by eccentric loads transferred through moment free connections of the girders.

It seems to me, however, that Professor Wilson's letter is apt to be interpreted in such a manner as if he had condemned, which I am sure was not his intention, rigid connections in steelwork for buildings in favor of the shear-connections designated as "bad" by Mr. Godfrey. I believe that Professor Wilson should have stated that the rigid connection, while increasing the bending moment in the column, operates very advantageously and economically in considerably reducing the moment in the girder, and that this is one of the many important reasons why the use of rigid connections should be recommended and encouraged.

EUGENE E. HALMOS,
New York City Designing Engineer.

Experience With Lugless Brick

Sir—I have read with interest your editorial comment under the heading "The Lugless Standard for Paving Brick," *Engineering News-Record*, Dec. 13-20, p. 845, on the action of the National Paving Brick Manufacturers' Association at their New Orleans convention.

There undoubtedly is a question as to the advisability of specifying lugless paving brick for use with all types of fillers. In June, 1918, about the time the war made necessary the curtailment of the paving brick output by 50 per cent, we were completing a paving job in Hays, Kan., on which the use of lug brick with asphalt filler was specified. The last eight or ten cars of brick shipped to us were of the lugless type. The brick were accepted and used only after considerable delay and after being advised by the brick manufacturers' association that only lugless brick were now being manufactured. The city came to the conclusion that it was a case of lugless brick or none, and so accepted them.

It was difficult to lay these brick so that they did not wedge together in such a way as to leave about 40 per cent of the joints open. However, owing to the heat of the season and the direct rays of the sun, the brick were hot enough so that little difficulty was experienced in filling the joints with asphalt. Under different seasonal conditions, from fall until late spring, is it advisable to use lugless brick with asphalt filler?

It is to be hoped that the National Paving Brick Manufacturers' Association will demonstrate the equality or superiority of lugless brick. Until then they should be experimented with cautiously.

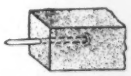
WILLARD C. HOLMES,
Hays, Kan. County Engineer, Ellis County, Kv.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Nail Cast Into End Holds Form Spacer in Position

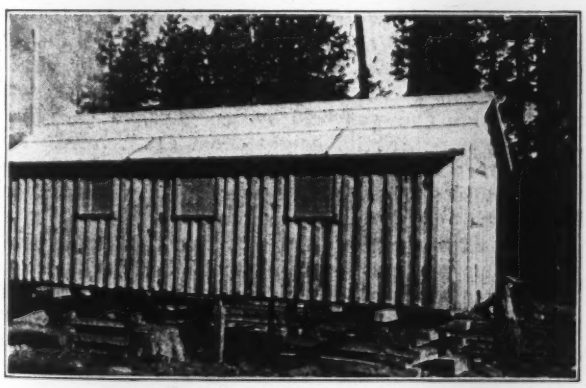
BY casting a small wire nail into the end of a precast concrete spacer for wall forms the spacer is "nailed" in position as the forms are erected, on a building operation at Jacksonville, Fla. Gang molds of job construction are used for casting the spacers, the nails being held in position to be cast into the spacers by inserting their pointed ends into gimlet holes in the mold partitions against which the ends of the spacers are molded. A 1:1 mortar is used for the spacers and the casting is allowed to harden two weeks before being used. In the forms the spacer is set so that its diagonal axis is vertical. These spacers are found exceptionally convenient, according to the December, 1919, issue of the *Contractors' Atlas* of the Atlas Portland Cement Co.



Standard Portable Bunkhouse on the Hetch Hetchy Project

THE City of San Francisco has adopted a standard design for bunkhouses on the Hetch Hetchy project. This is not only to simplify material billing and construction, but in order to fit in with the necessity for moving camp frequently. Because practically all parts of the work are reached by the city's 68-mile railroad, it is desirable to use bunkhouses that can be readily loaded on a flat car.

Two standard sizes are in use, a 10-ft. x 16-ft. house for eight men and a 10-ft. x 30-ft. house for sixteen men. Both use two tiers of bunks. The design calls for 2-in. x 4-in. studding, 4-in. x 4-in. corner posts and battons over the joints between the 1-in. sheathing. There is nothing unusual about the design except, perhaps, that the 4-in. x 6-in. floor plates are always used in full length pieces to afford a substantial "bottom" on which the house can be jacked up and skidded. The frame is well braced to withstand the racking incidental to moving, and a tar-paper roofing keeps the weight to a minimum. The lumber in the larger size structure totals only about 3,000 ft. b.m. Where a camp is to be maintained for a short time only, the custom is to skid the bunkhouse from flat car onto a crib built up alongside to suitable height and leave it there until the next move is in order.



BUNKHOUSE COMBINES STABILITY AND PORTABILITY

The work on the Hetch Hetchy project is under the direction of M. M. O'Shaughnessy, city engineer of San Francisco.

Close Regulation Makes Winter Concreting Safe

BY G. A. STOCKHUS
Ross P. Beckstrom Construction Co., Rockford, Ill.

WORKMEN schooled in the methods followed and trained to leave nothing to chance make concrete construction in cold weather entirely safe. With the functioning of the human element thus assured, the mechanical equipment needed and the methods employed are so simple that they are within the means of any building contractor. They are the only means employed by the construction company with which the writer is connected, and it has never been compelled to stop work because of winter conditions.

An example of winter concreting procedure is furnished by the three-story concrete building, 156 x 66 ft., under construction at Rockford, Ill. In preparing to concrete a floor of this building, care is first taken to stock-pile all the aggregate required so that the heating apparatus may have from 24 to 36-hr. action on the material before any is used. There must be absolute certainty that no frosted material gets into the mixer, and long heating is necessary to give this assurance.

On this operation the steam boiler is large enough to run four steam lines into the sand and gravel and also a 1-in. service line to the floor to be concreted. This line is branched off into lines laid along the center of each bay and the full length of the building. These branch lines have connections for steam hose. With the hose, column and beam forms are steamed out just ahead of the pouring until there is no possibility of accumulated ice or snow remaining. The corrugated dome forms in particular are steamed carefully, as ice forms easily in the corrugations and, being transparent, is easily overlooked. It is the sole task of one man to do the steaming, keeping just ahead of the pouring operations.

Steam-operated mixers are, for safety, employed in all winter work. They are less liable to be shut down by winter conditions. The heated materials are mixed with boiling water so that the concrete virtually begins to set as soon as it is deposited. As fast as the slab is poured it is covered with a thin tarred paper on which is spread about 6 in. of wild slew hay. This slew hay holds the heat much better than tame hay or straw. Within 48 hr. after the floor is poured and protected as described the column forms for the next floor can be erected. As each story is ready it is closed in tightly by canvas side curtains. Great care is taken

in placing these curtains to close every opening by which air enters. Salamanders keep the inclosed space warm.

The practice employed embodies no new methods or appliances, except in the one respect that every procedure is carefully watched and no single thing is left to chance. On this care, and in the training of the workmen, rests the success of winter concrete-building construction.

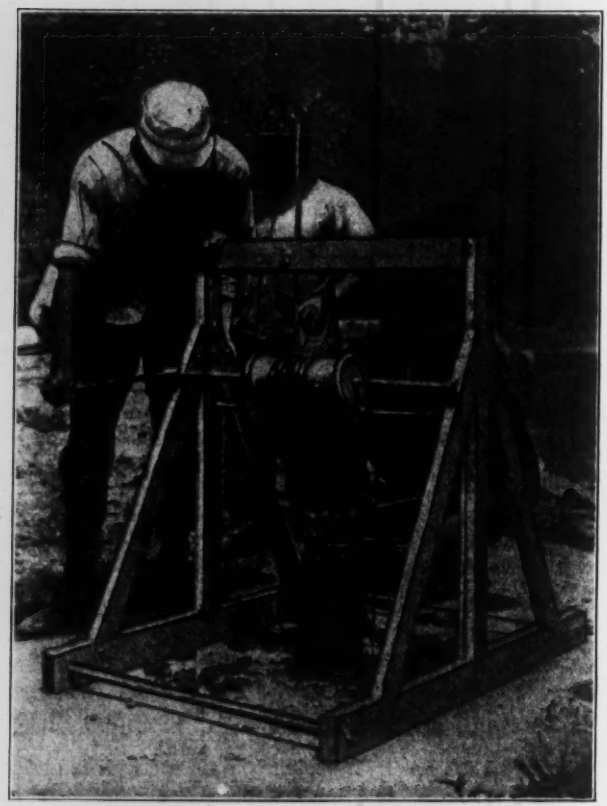
Crown of Concrete Base Checked by Chalk Line

By H. H. Sitterley
Bath, N. Y.

TROUBLE in maintaining the crown in a concrete base for pavement being laid by men new to the work, was overcome by fashioning a chalk line templet which was so light that its frequent and rapid use was possible. At the center, the quarter and the eighth points of the line, which reached from curb to curb, knots were tied and a loop of heavy wire was tied into each knot. The wire loops were of the proper length just to touch the planned curve of the crown when the line was stretched taut between curb tops. With this "templet" the untrained men could check their work every few feet and as a result a neat job was secured.

Slump Test Device for Field Use

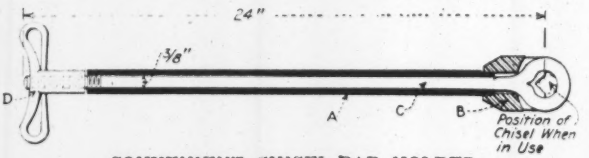
SLUMP tests of concrete were accurately and quickly made for a 60,000-sq.yd. paving operation at Winnetka, Ill., using the windlass device shown by the illustration. In operation, the windlass was set on the sidewalk with a square of sheet metal under the cylinder to keep the walk clean. The concrete is well tamped into the cylinder, which is of metal and 6 x 12 in. in size, and then the windlass lifts the cylinder clear of the molded sample by a direct vertical pull. The illustration shows a satisfactory test, the concrete cylinder having retained its original shape almost perfectly. According to the specifications of the Illinois Division of Highways, concrete which is to be machine tamped is required to show a slump not exceeding 2 in., and concrete which is to be hand tamped is required to show a slump not exceeding 4 in. The contractor for the Winnetka paving was the Marquette Construction Co. Windes & Marsh, Winnetka, Ill., were the engineers.



PORTABLE WINDLASS FOR SLUMP TESTS

Chisel-Bar Holder Prevents Hammered Hands

A HOLDER which grips a chisel-bar tightly in any position, and can be quickly attached and removed, is illustrated by the accompanying drawing from the Rochester Railway & Light Co. A pipe sleeve *A* with a screwed on socket or head *B* is slipped onto a bar *C* threaded at one end and having an eye at the other end. By means of the hand-nut *D* the eye of the bar is moved in or out with respect to the head *B* so as to grip or let loose the chisel-bar. A rubber or leather bushing in the socket reduces the jar to the hands of the man holding the chisel.



CONVENIENT CHISEL-BAR HOLDER

Acetylene Torch Repairs Standing Steel Derrick-Mast

By J. C. Lamon
Maryville, Tenn.

BENT by a blow from a "high" boom, the trussed steel mast of a derrick employed on the Cheoah Dam at Alcoa, Tenn., was repaired standing by means of a gin pole and an acetylene torch. The mast was 110 ft. high and was held by ten guys. It was bent at about one-third its height from the bottom. The procedure was to erect a gin pole and by block and fall, hitched above the bend, to take the strain off the bent truss members. To accomplish this the guys leading off from the bent side were slacked. With the mast supported by the gin pole the bent members were cut out by means of an oxyacetylene torch; the mast was then pulled plumb and new members were inserted. These new pieces were well reinforced. The Cheoah Dam is a portion of the hydro-electric development of the Knoxville Power Co., on the Little Tennessee River.

Sanded Wood Block Not Slippery

New wood block pavement in Minneapolis, Minn., is spread with a thin layer of torpedo sand to prevent slipperiness. The sanding is the final construction operation prior to admitting traffic onto the pavement The sand is sprinkled with water to keep it from being blown off while the traffic is grinding it into the top fibers of the wood block.

NEWS OF THE WEEK

New York, January 22, 1920

Arthur Powell Davis Elected President, Am. Soc. C. E.

New Society Head Is Director U. S. Reclamation Service—In Government Work Since 1882

Arthur Powell Davis, whose election to the presidency of the American Society of Civil Engineers was announced at the annual meeting in New York City this week, is best known as the director and chief engineer of the U. S. Reclamation Service. Assuming office as the technical head of that organization in 1907, following the resignation of F. H. Newell. Mr. Davis brought to his new duties an experience of 25

ARTHUR P. DAVIS, PRESIDENT AM. SOC. C.E.

years in irrigation hydrography, topography, steam-flow investigation and other subjects closely allied to those which were of such fundamental importance in the Federal program of developing vast areas of the arid West. The bulk of his professional work has been done for the Government, where

(*Concluded on page* 201)

Civil Engineers in Annual Meeting Endorse Development Report

Debate and Approve Questionnaire and Refer It to Board of Direction to Be Sent Out to Letter Ballot

The sixty-seventh annual meeting of the American Society of Civil Engineers was held in New York, Jan. 21 and 22. As usual the reports of the Board of Direction, the secretary and the treasurer were received, technical committees made progress reports, and the new officers were declared elected and inducted into office. Chief interest at the meeting centered upon the report of the Committee on Development, the result being the adoption of a questionnaire on the chief points in the committee's report, which questionnaire, with, possibly, additional questions framed by the board through a committee of seven, is to be sent out to a letter ballot of the membership.

The consideration of the Development Committee's report was marked by much aimless discussion, by badly mixed up parliamentary procedure, and by interminable debate over inconsequential matters and parliamentary questions. The Board of Direction sent to the meeting resolutions which it had adopted, stating that it was "in sympathy with the objects sought in the report of its Development Committee, and with the view of its special committee [of which John W. Alvord was chairman] already approved as an alternative by the Development Committee, that Engineering Council should be made more representative of the engineering and allied technical profession, and that its functions should be broadened and more liberally supported financially," and that it was desirable that the main questions involved in the Development Committee's report should be submitted to the society for action by letter ballot "as soon as possible." The Board, therefore, recommended to the incoming Board of Direction that a committee of seven be appointed to prepare and submit to the membership "forthwith" a questionnaire covering the essential recommendations of the Development Committee and any recommendations and instructions of the Annual Meeting relating to the subject. It also recommended to the incoming Board that the necessary appropriations be made to meet the expenses of said committee of seven. In addition, the Board submitted for discussion by the Annual Meeting eight questions, covering important points in the Development Committee's report. These questions were:

1. Shall the Annual Meeting be supplemented by spring and fall meetings?
2. Shall the *Proceedings* be extended by including abstracts of important engineering articles?
3. Shall local sections be established to embrace the entire membership?
4. Shall the directors be nominated and elected by vote of the corporate members residing in the respective districts?
5. Shall a portion of the dues be allotted to sections?
6. Shall the officers at large be nominated by representatives of local sections in an annual conference?
7. Shall the present grades and requirements for membership be revised?
8. Shall the Board arrange for the establishment of civil engineering student membership?

The Board of Direction also referred for discussion by the Annual Meeting four questions, three on joint activities with other engineering societies and one on increase in dues, included in the report of the Alvord committee.

R. L. Humphrey's Resolution

Immediately upon the reading of these resolutions of the Board, Richard L. Humphrey proposed a lengthy resolution, setting forth the authority of and directions to the Committee on Development, providing for the approval of the fundamental recommendations of the committee and the submission of a questionnaire of nine questions to the membership for letter ballot. Upon motion it was decided to take up the Humphrey resolution rather than the questionnaire proposed for discussion by the board. That resolution was therefore made the first order of business upon reconvening after the luncheon recess.

Immediately upon reconvening, it was moved to take up first the questions included in the Humphrey resolution, and to pass on them one by one. Approval of the questions, it was pointed out would direct the Board to send out the questions without alteration to letter ballot.

Question One

Question one was as follows: Shall the American Society of Civil Engineers adopt the principle of becoming an active national force in economic, industrial and civic affairs?

The propounding of the question was the signal for the start of dragging discussion which continued for two full hours. There was little direct discussion of the question. Objection was made to it by Gen. William M. Black on the score that it was so indefinite that the society might engage in activities far removed from its legitimate field. Several speakers replied that the engineer could no longer hold himself aloof from action on public questions of an engineering character. M. O. Leighton, in rather extended remarks endeavored to interpret the feeling of members in outlying districts, and declared that the demand was general for greater activity by the society. He said that if the society did not act, another society (referring to the American Association of Engineers) would. In this discussion the cleavage between the conservative and the progressive members became plain, the conservatives being fearful of an expansion of activities, the progressives being insistent that it was necessary.

The time consumed on this question, however, was due to the failure of the President to confine the discussion to the question before the house. In the midst of the debate, despite the fact that a motion was pending, and that the meeting had moved to take up the Humphrey resolution first and subsequently had voted to take up the questions of the Humphrey resolution one by one, he entertained a motion, made by Samuel Whinery, to approve the questionnaire of the Board of Direction. Points of order availed not, and apparently some members felt that the entertainment of the motion opened up every question pertaining to the report. In that view the President did not check them. The Alvord report came in for severe criticism as being a superficial study of the development report, and severe strictures were passed on the past inaction and management of the society. At times the remarks were acrid. Finally, the charge was made there had been suppressed a letter sent by the Development Committee to the Board with its report, suggesting that certain questions, included in the letter, be sent out for letter ballot at the time the report was distributed. The secretary stated that this letter had been received and read to the Board when the report was presented, but no explanation was made why the Board did not send out the questions with the report.

At length the patience of the members became exhausted by the delay and cries of "Question. Question," forced the President to put the question on the Whinery motion. It was lost by an overwhelming majority, indicating again what had become clear at the morning meeting that the majority of those present was overwhelmingly in favor of approval of the Development Committee's report, and would brook no procedure that would sidetrack it or that would allow any disposal of it by the conservatives.

The Whinery motion being defeated, the original motion, to approve question 1 was put, and carried practically unanimously.

Remaining Questions

The following questions attended with more or less delay were then approved:

2. Shall the Society actively co-operate with other engineering and allied technical societies in promoting the welfare of the engineering profession?

3. Shall the Society co-operate in the formation of the comprehensive organization provided for in the Joint Conference Committee report?

4. Shall the recommendations of the committee regarding technical activities be approved?

5. Shall the Society be divided into sections to embrace all members?

6. Shall the directors in each geographical district be nominated and elected by vote of the corporate members resident therein?

7. Shall a portion of the Society dues be allotted to local sections?

8. Shall the present nominating committee be abolished and candidates for the offices of president, two vice-presidents and treasurer be nominated by representatives of local sections in annual conference?

9. Shall the dues of all non-resident members above the grade of junior be increased to provide for greater activities of the Society, said increase not to exceed $5 per annum?

Upon the approval of these questions the main resolution itself was brought up for action, said resolution directing the Board of Direction to submit the preamble, resolution and the questionnaire to a letter ballot of the corporate members. This was amended to require the Board to send out the questionnaire by Feb. 16 and to canvass the replies in not less than 50 nor more than 60 days thereafter. The resolution was passed.

A resolution was also passed authorizing the Board to add any questions that in its judgment were needful to develop the opinion of members.

During the debate the incoming president announced that the following members would be proposed to the incoming Board of Direction to prepare the questionnaire to be sent out for letter ballot: A. N. Talbot, Leonard Metcalf, M. S. Ketchum, Harry Hawgood, John C. Hoyt, H. S. Crocker and C. C. Elwell.

There was practically no discussion on the merits of the Development Committee's proposals; in other words, due to the loose conduct of the session, the annual meeting will contribute little or nothing toward helping the members vote intelligently on the questionnaire.

Support for "Progressive" Platform

President Davis, after being escorted to the platform at the morning session by Professors Talbot and Swain, elicited enthusiastic applause when he said: "I am in sympathy with the progressive movement in the Society." He referred also to the forces of "conservatism and backwardness" which had allowed other organizations to enter the field of effort which should have been occupied by the American Society of Civil Engineers. The work done by some of these outside bodies, Mr. Davis maintained, could have been better done by the American Society if the latter organization were progressive.

New Officers Elected

The election of officers of the Society for the ensuing year brought out a total effective vote of 2,041 with the following results: President, Arthur Powell Davis, 2,029 votes; vice-presidents, R. A. Cummings, 2,033 votes, and F. L. Stuart, 2,018 votes; A. S. Tuttle, treasurer, 2,040 votes; directors, Carleton Greene and C. W. Hudson for District 1; J. A. O'Connor for District 3; J. C. Hoyt for District 5; Anson Marston for District 7; and D. C. Henny for District 12.

The annual report of the Board of Direction indicated a net increase in membership for the year of 475, as compared with 343 for the previous year. There were 90 losses by death during the year. Members in the naval and military service of the United States and the Allies numbered 1,823. Total deaths reported in service were 26. The total membership on Jan. 1, 1920 was 9,408.

A canvass of districts for nominations for new members of the nominating committee was reported and the following new members were elected by the meeting: First district, C. R. Hulsart; second district, C. R. Gow; fourth district, W. L. Stevenson; seventh district, L. P. Wolff; eighth district, Dabney H. Maury; ninth district, A. O. Cunningham; twelfth district, J. C. Stevens.

Arthur Powell Davis Elected President, Am. Soc. C. E.

(*Concluded from page* 199)

He began service in 1882 as assistant topographer with the U. S. Geological Survey. Because of the detailed knowledge, which he acquired in succeeding years, however, his advice has been sought on many special problems, involving trips to Russia, at the request of that Government, and to the Panama Canal, as member of a board of engineers named by President Roosevelt.

Mr. Davis was born in Decatur, Ill., Feb. 9, 1861. He graduated from the Kansas State Normal School and entered the U. S. Geological Survey in 1882 as an assistant topographer, in which capacity he was in charge of a leveling and barometric party in North Carolina and Tennessee until the end of the year. During 1883 he was in charge of a topographic party making a plane table contour map of Mount Taylor and vicinity in New Mexico. Promoted to the grade of topographer, his next year was spent in triangulation work in northeastern Arizona, Utah and New Mexico, and followed by three years as chief of the Topographic Section, Plateau Region. He had charge of a section of the Irrigation Survey in the years 1888, 1889 and 1890, after which he was transferred back to the Geological Survey where he was in charge of the Southwestern Topography Section until August, 1894. He was then assigned to the Division of Hydrography, and for the ensuing year traveled in the West, establishing stations, gaging rivers, and instructing assistants in hydrographic work, becoming in December, 1895, Expert Hydrographer in planning a system of irrigation for the Pima Indian Reservation, Ariz., where, for six months, he engaged in field work, which included experiments to determine amount of underflow, surveys of reservoir sites, and plans for two high dams. From May, 1896 to December, 1897 he was in charge of all stream measurements in the United States carried on by the Geological Survey, and during the succeeding two years was in charge of all hydrographic investigations connected with the surveys of the Nicaragua Canal route, afterward resuming his irrigation investigation work in Arizona. During the years, 1898 to 1901, inclusive, in addition to his other duties he was hydrographer of the Isthmian Canal Commission, and in charge of the Panama hydrographic surveys.

He succeeded F. H. Newell as Chief Engineer of the Reclamation Service in 1907, and as Director of the Service in 1915, and his work in those offices have won him an enviable international reputation in reclamation matters. In 1909 Mr. Davis was a member of a board of engineers which accompanied President-elect Taft to investigate conditions of the Panama Canal work and to report upon the feasibility and safety of the Gatun dam. As consulting engineer he has served the Isthmian Canal Commission, the Russian Government, and several large irrigation projects in the American colonies.

George Washington University conferred on Mr. Davis the degree of A.B. in 1888 and of Doctor of Science in 1917. He became an associate member of the American Society of Civil Engineers June 7, 1893 and a member October 4, 1899. He has just completed a term of service as director of the Society. He is also a member of the Washington Academy of Sciences, of which he was vice-president in 1908, and the Washington Society of Engineers, of which he was president in 1907. He is a member of the National Geographic Society and of the Cosmos Club.

Besides being a frequent contributor to the magazines on scientific subjects, Mr. Davis is the author of the following publications: "Elevation and Stadia Tables," 1893; "Progress of Stream Measurement," 1897; "Irrigation Near Phoenix, Arizona," 1897; "Irrigation Investigation in Arizona," 1898; "Hydrography of Nicaragua," 1899; "Hydrography of the American Isthmus," 1902; "Water Storage on Salt River, Arizona," 1903; "Irrigation Works Constructed by the United States Government," 1917.

Engineering Council Names Military Affairs Committee

At a meeting of the American Society of Civil Engineers on Oct. 15, 1919, in New York City, the subject of the relations of the engineer to the future military activities of the United States was discussed by a number of engineers from the Army and civil life, and a resolution was passed referring the matter to Engineering Council for action.

Engineering Council has appointed a Military Affairs Committee, which consists of the following: William Barclay Parsons, Harold W. Buck, Roger D. Black, George Gibbs, Fred J. Miller, T. Spencer Miller, F. A. Snyder, G. D. Snyder, Leonard Waldo, Paul G. Brown, Lincoln Bush, W. A. Starrett, H. S. Crocker and G. R. Solomon.

The committee organized Jan. 7, 1920, with Colonel Parsons as chairman, and Major Snyder as secretary. The committee will make a study of the problem of utilizing the technical resources of the nation, in both men and material, in the event of war, and desires the co-operation of the technical men of the country in the form of suggestions and information.

Iowa Divided into Road Districts

For administrative purposes Iowa has been divided into nine road districts. A district engineer is in charge in each district, those engineers being: District No. 1, W. F. Beard, Ames; district No. 2, Raymond Zack, Mason City; No. 3, E. W. Dunn, Sioux City; No. 4, L. W. Martin, Atlantic; No. 5, J. S. Morrison, Ottumwa; No. 6, W. M. Lee, Cedar Rapids; No. 7, J. W. Mercer, Waterloo; No. 8, John E. Reynolds, Storm Lake; and No. 9, W. O. Price, Chariton.

Col. L. H. Beach Nominated for Chief of Engineers

Choice of New Corps Head Is Surprise to Majority Who Expected Appointment of Langfitt, Abbot or Jervey

Nomination of Colonel Lansing H. Beach to be Chief of Engineers, U. S. Army, came as a surprise to those who had been watching the various campaigns being conducted by the friends of the several officers who came within the range of eligibility. In some quarters it was expected that the Secretary of War would recommend Colonel Frederick V. Abbot. Many felt sure that the honor would go to Colonel William C. Langfitt, who had General Pershing's recommendation. The Secretary of War himself had furnished some encouragement to those who were anxious to see Colonel Edward Burr fill the place. Colonel Henry Jervey also had powerful backing from the Chief of Staff. It may be said that practically all were agreed that Colonel Beach had little chance for the appointment. It had been recognized, however, that Colonel Beach had made a host of friends in the Mississippi Valley and that they were tireless in their activities in his behalf.

While Colonel Beach is best known for the work he has done in connection with Mississippi River projects he has had a long public works experience of the type commonly afforded engineer officers. He has done extensive engineering work on Great Lakes projects and was in charge of the important improvements of the harbors of Baltimore and Jacksonville. While District Engineer at New Orleans he had charge of a wide range of activities in Alabama, Mississippi, Louisiana and Texas. More recently he has been stationed at Cincinnati in charge of the construction of the system of locks and movable dams being constructed in the Ohio River.

As a member of the Mississippi River Commission and as a member of the Board of Engineers for Rivers and Harbors, and as an advisor to the Waterways Division of the Railroad Administration, Colonel Beach has been prominently identified with the development of inland waterways.

An account of Colonel Beach's advance in rank is given very briefly as follows:

Born in Iowa June 18, 1860 and appointed to the U. S. Military Academy from Iowa; became Cadet, M. A., July 1, 1878; 2nd Lieut., June 30, 1882; 1st Lieut., Jan. 10, 1884; Captain, Oct. 4, 1894; Major, Feb. 20, 1903; Lt. Col., Feb. 28, 1908; Colonel, Feb. 27, 1913.

His duties were as follows: Served with Battalion of Engineers at Willett's Point, N. Y., Oct. 21, 1882 to Oct. 31, 1884; Assistant to Major Mansfield to June 6, 1885; Member of Commission to mark boundary line between Indian Territory and State of Texas Sept. 1885, and Disbursing Officer of the Com-

mission to Nov. 7, 1888, and Assistant to Lt. Col. Merrill to Aug. 1889; Instructor at Military Academy to Aug. 17, 1893; on River and Harbor work at Galveston, Texas, to Nov. 6, 1894; at Washington, D. C., as Assistant to Engineer Commissioner, to May 31, 1898, and Engineering Commissioner, to Nov., 1901; at Detroit, Mich., in charge River and Harbor work and 11th Lighthouse District to Aug. 17, 1905; Instructor of Engineering at Army Staff College, Ft. Leavenworth, Kan., to Aug. 23, 1907; in charge River and Harbor work at Jacksonville, Fla., to Aug. 3, 1908; on duty at New Orleans, La., as Engineer, Gulf Division, to Aug. 17, 1912; at Baltimore, Md., Baltimore Engineer District to July 31, 1915; Division Engineer, Central Division, and Engineer, 14th Lighthouse District at Cincinnati, O., to date.

Colonel Beach has been a member of a board consisting of one representative each from War, Navy and Treasury Departments to make recommendations to the Secretary of the Treasury concerning anchorage of vessels in United States Territorial waters since March 12, 1918; and in addition to other duties was detailed as Superintendent of Lighthouses in the 14th Lighthouse District to superintend the construction and repair of any aid to navigation authorized in that district.

The Senate's confirmation of Colonel Beach's appointment has not been announced yet, but it is regarded as certain.

Authorized Road Bond Issues Total Nearly $500,000,000

According to figures compiled by the Portland Cement Association of Chicago, $772,943,500 in road bonds have been proposed by the states and their constituent counties, and in addition $493,865,490 in bonds were authorized during the first nine months of 1919. Those figures include a few bond issues authorized late in 1918.

Analysis of the Portland Cement Association's figures indicates that the counties have made the largest appropriations in the past, but $215,000,000 of the amount authorized being state appropriation. However, of the 1920 schedule of proposed authorization totaling $772,943,500, $575,000,000 represents states' share. Included in this $575,000,000, however, is a bond issue of $75,000,000 proposed for the State of Texas, a measure which was defeated by a close vote in the November election.

It is interesting to note that during 1920 sixteen states will vote upon the proposition of bonding themselves for highway construction, the total of these sixteen proposed issues being exactly half a billion dollars. Eleven of the sixteen states will consider the bond issue question at the November, 1920, election, the total for these proposed bond issues being $369,000,000. Minnesota proposes the authorization of the largest issue—$100,000,000—the other states following as indicated: Kansas, $60,000,000; Missouri, $60,000,000; West Virginia, $50,000,000; Washington, $30,000,000; North Carolina, $25,000,000; Mississippi, $20,000,000; Montana, $15,000,000; Colorado, $5,000,000; and Idaho and New Mexico, each $2,000,000.

Other states that will consider bond issues at elections during 1920, and the amounts proposed are: Wisconsin, $50,000,000; Georgia, $40,000,000; Alabama, $25,000,000; Arkansas, $15,000,000; and Rhode Island, $1,000,000. Bond issues which were voted either late in 1918 or during 1919 and which will provide part money for road construction during 1920 include the following states with the amounts authorized: Illinois, $60,000,000; Michigan and Pennsylvania, each $50,000,000; California, $40,000,000; Oregon, $10,000,000; Wyoming, $2,800,000 and Nevada, $1,000,000.

Fuller Company Buys Shipyard From United States Shipping Board

On Jan. 1, the George A. Fuller Co., building contractors, took over and will operate the Shipping Board agency yard at Wilmington, N. C., operated during the past year by the Carolina Shipbuilding Corporation. The Fuller company has bought the yard from the Shipping Board, and intends to engage permanently in shipbuilding, with the following organization: Paul Starrett, president; L. C. Dilks, vice-president; Ralph Starrett, works manager; Henry Vogt, assistant secretary and treasurer; J. R. Preston, technical manager; E. G. Glass, supply manager. The Carolina corporation was a subsidiary of the Fuller company organized to carry out an agency contract with the Shipping Board for constructing the yard and building twelve 9600-ton steamers. Under this contract the yard was built and started up in 1918. It was the fourth (and last) agency yard authorized, and is the first to be sold.

The Fuller company will complete, for the Emergency Fleet Corporation, eight of the 12 ships of the original contract, and will build the other four for its own account. The yard, located three miles from Wilmington on the Cape Fear River, has four concrete shipways 450 ft. long.

Engineers Chosen for New Bridge at Springfield, Mass.

The firm of Fay, Spofford & Thorndike, consulting engineers of Boston, has been selected to supervise the construction of the new bridge over the Connecticut River at Springfield, Mass. The fee is to be 2½ per cent of the construction cost, the latter being estimated at $4,000,000. The plans for the structure were prepared by Fay, Spofford & Thorndike.

Water Power Bill Passes Senate

Now Goes to Conference Between House and Senate for Formulation of Compromise Bill

Passage in the Senate on Jan. 15 of the Water-Power Bill practically insures the final enactment of legislation which has been under consideration in Congress for more than ten years. The bill provides for a Federal Power Commission which is to have broad authority in issuing licenses for the use of water power. As passed by the Senate the bill is considerably more liberal to those who may undertake the development of water power than is the measure which passed the House some months ago. This attempted liberalization brought forth a determined fight by Senator Lenroot, the leader of the opposition, who sees in the conditions made by the Senate the probability that the licenses issued practically will be perpetual. On the other hand, the majority of the Senate was very firm in its belief that the liberalization is necessary in order to insure the investment of capital in power development. Senator Lenroot characterized the action of the Senate as giving away the last of the public's great resources, and predicted that the President will veto the measure if the Senate provisions should be held in the bill by the conferes. It is recognized that numerous changes will be made in the conference.

Among the amendments made in the Senate was the one authorizing the expenditure of $25,000,000 for the development of a power project at Great Falls on the Potomac River. Another amendment transfers to the Federal Power Commission the advisory powers granted some years ago to the Newlands Waterways Commission. That Commission was authorized to study reclamation, flood control and all uses of water, and to report its findings to Congress. It is regarded as likely that the Great Falls project and the Newlands Commission provision will be stricken out in conference. A third amendment provides that the secretary of the proposed Water Power Commission is to be a member of the Corps of Engineers, U. S. Army.

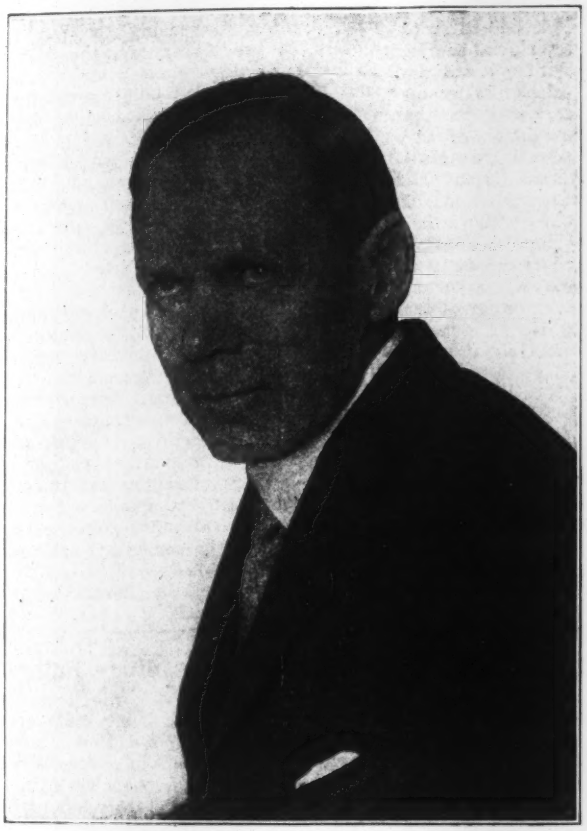
Newark Zoning Ordinance Adopted

After moving to take amendatory action establishing Broad St. as a business thoroughfare for its entire length south of Market St., the City Commission of Newark, N. J., passed the zoning ordinance Dec. 31. South Broad St. had been designated residential between Camp and Astor Sts., but owing to pressure brought to bear by a delegation of Broad St. residents, the amendatory action was proposed, so as not to prevent the final passage of the new code. Except for a few minor changes removing certain restrictions on "light industries," the zone ordinance is the same as published in *Engineering News-Record*, Dec. 25, p. 1045.

Dr. R. C. Maclaurin, Eminent Educator, Is Dead

President and Developer of Greater M. I. T. Was Stricken at Height of Brilliant Career

Dr. Richard Cockburn Maclaurin, since 1908 president of Massachusetts Institute of Technology, died at his home in Cambridge, Mass., Jan. 15. He succumbed to pneumonia in the prime of a remarkably constructive life devoted to higher education, being only fifty years old at the time of his death. That he had received the Cambridge University degrees of Sc.D. at the age of 28, LL.D. at 34, and become president of M. I. T. at 38 is evidence of his versatility and brilliance. His ability as an organizer, financier, and developer of educational institutions was no less remarkable than his attainments in science and law.



DR. RICHARD C. MACLAURIN

Richard Cockburn Maclaurin was born in Lindean, Scotland, in 1870. His early boyhood was spent in New Zealand, whence he returned to England to complete his preliminary education. In 1892 he entered the University of Cambridge, where he held a foundation scholarship in St. John's College. He took two degrees at Cambridge, B.A. and M.A., the thesis work for the latter being advanced mathematics. He received the Smith prize for excellence in mathematics, and upon graduation was elected Fellow of St. John's College.

Leaving Cambridge, Dr. Maclaurin next spent ten months in the United States and Canada (1896-97) studying and visiting educational institutions and spending much time at McGill (Toronto) and Leland Stanford universities. Returning to England he re-entered Cambridge, this time to study law, and was awarded the McMahon law studentship, the most highly valued of its kind in the University.

In 1898 Dr. Maclaurin was appointed professor of mathematics in the University of New Zealand, became a trustee of the University, and took an active part in the organization of technical education in that colony. He became dean of the faculty of law in the University in 1903 and continued in that capacity for the next four years. In 1898 Cambridge University honored him with the degree of Doctor of Science and again in 1904 with the degree of Doctor of Law.

He was invited to take the chair of mathematical physics at Columbia University, New York City, in 1907, and a year later was made head of the Department of Physics. Dr. Maclaurin was appointed president of Massachusetts Institute of Technology, Nov. 23, 1908, succeeding Henry S. Pritchett, who had retired to become chairman of the Carnegie Foundation. At that time Massachusetts Institute of Technology had reached the limit of its facilities and still fell far short of fully carrying out the plans of its founders. Its buildings, equipment and funds were only a fraction of its needs. Dr. Maclaurin undertook to make up the deficiencies.

First he unified the corporation and the faculty, and by his personality gained the confidence of the alumni and bound them as never before into a great force working for the benefit of their Alma Mater. One of the first fruits of his efforts was the gift of T. Coleman du Pont of half a million dollars toward the purchase of a new site for Technology at Cambridge. The corporation at the same time made up another quarter-million which completely paid for the land. Following this, with the aid of the alumni, he secured the passage of a Massachusetts act granting additional funds for the support of the school.

When the site question was settled it was necessary to procure enormous sums for the construction and maintenance of plant, and with the enthusiastic support of the alumni Dr. Maclaurin undertook to raise them. First came the gift of $2,500,000 from George Eastman, of Rochester, N. Y., which was closely followed by other gifts in sufficient measure to warrant the beginning of construction. Subsequent gifts from Mr. Eastman, made before 1919, amounted to $4,500,000, and finally, only a few months ago, was made his offer of $4,000,000 contingent upon the raising of an additional $8,000,000 for proper financing of the Institute. At an alumni dinner in Boston, Jan. 10, it was announced that the $8,000,000 had been made up, that Mr. Eastman had made good his $4,000,000 promise and that the Massachusetts Institute of Technology now has an additional endowment of $12,000,000.

Dr. Maclaurin must be directly credited with the creation of the organization and the spirit which made possible the surpassing facilities for technical education now possessed by the institution whose affairs he so ably guided.

Date for Annual Meeting of A. G. C. Changed

Owing to the fact that the executive board was confronted with so much detail in the preparation of plans for the annual meeting of the Associated General Contractors of America, the date has been advanced one month. It will be held in Chicago, Feb. 18 and 19.

The tentative program says that the morning session of the first day's meeting will be devoted to routine matters, and the afternoon session taken up with discussions of the lump-sum and cost-plus forms of contract, and industrial relations. A smoker will be held the evening of Feb. 18. The morning of the 19th will be devoted to routine matters, and in the afternoon session the conference will be divided into four divisions: Building contractors, highway contractors, railroad contractors, and public works contractors. The most important questions in each field will be discussed at these division conferences. The annual banquet will be held in the evening of the second day's conference.

Denver Water Rates and Home Rule

Notwithstanding the fact that Denver, Col., has a home-rule charter the rates charged by it for water supplied to outside municipalities are subject to regulation by the state utilities commission, according to a decision handed down by the State Supreme Court on Dec. 31 in Star Investment Co. of Aurora vs. the City and County of Denver.

H. T. Cory To Pass on Nile Irrigation Plans

H. T. Cory sailed this week for England, whence he will proceed to Egypt as one of three members of an international consulting commission to pass on plans for irrigation work in the Nile Valley. His fellow-members of the commission, whose names have not yet been received in this country, will be an English engineer and an engineer from India. So far no information has come indicating the reason for choosing Mr. Cory for this important position, but it may be assumed that his choice is the result of the international fame which he won by his success in closing the break in the Colorado River levee and diverting the stream from its flow into the Salton Sea, and by his subsequent work as chief engineer of the Imperial Valley Irrigation system. In addition, he has had a wide experience through the West on irrigation projects of varied types, and for the last two years has been acting as consulting engineer to the United States Reclamation Service, reporting upon the development of swamp and cutover lands, in connection with proposed soldier-settlement plans.

H. T. CORY.
On International Consulting Commission in Egypt

Mr. Cory was graduated from Purdue University in 1887 in mechanical engineering, at the age of seventeen, and subsequently received master's degrees in both civil and mechanical engineering from Cornell University. His early experience was in both railroad and city engineering work. In 1893 he became professor of civil engineering at the University of Missouri and remained there until 1898. For three years he was dean of the engineering department and professor of civil engineering at the University of Cincinnati, meanwhile engaging in consulting work for the Mexican Central, the Texas & Pacific, and the Southern Pacific railroads. For a year he was assistant to the general manager of the Southern Pacific, remaining in that capacity until he was called upon to do the herculean task of diverting the Colorado River to its original course. This accomplished, he became assistant to the president of the Associated Harriman lines in Arizona and of the Southern Pacific in Mexico, carrying on also, for a period of four years, the work of general manager and chief engineer of the California Development Co. and its associated corporation in Mexico, both together controlling the irrigation system of the Imperial Valley. Mr. Cory's work in the diversion of the Colorado River was so spectacular that it has been immortalized in two novels, "The Winning of Barbara Worth" and "The River."

Since the termination of his connection with the Imperial Valley irrigation system in 1910, Mr. Cory has engaged in consulting practice, which has led him into practically every state in the arid West.

Chicago Sanitary District Stops Proposed Road Work

As part of a policy of retrenchment the Sanitary District of Chicago has voted to postpone the construction of roads along the banks of the drainage canals. The total amount eliminated from the estimates is $3,305,000 and includes the following items: Road along main channel, $1,500,000; road along north shore channel, $800,000; stone-crushing plant for road work, $280,000; bridges and subways along proposed roads, $425,000; California Ave. bridge, $300,000.

Consulting Engineers Hold Annual Meeting

The annual meeting of the American Institute of Consulting Engineers was held in New York, Jan. 19, with an attendance of thirty-seven. Announcement was made of the election of three new members, Lieut. Col. G. D. Snyder, New York; Edwin Ludlow, Landsford, Pa., and Frank N. Waterman, New York, bringing the total membership to eighty-seven. The following members were elected to serve on the council of the institute for a period of three years: Alexander C. Humphreys, Dugald C. Jackson and George W. Fuller.

A resolution was adopted urging on Congress the passage of legislation, now pending, increasing the pay of officers of the Army and the Navy. Frank J. Sprague made a strong presentation of the case, pointing out that the pay has not been raised to meet the increase in cost of living, that skilled labor is getting wages equal to the pay of a Navy commander, that the number of resignations from the services is alarmingly large, and that, in consequence, the morale of the service has been seriously affected.

The topics set for discussion were: "The Future of the Consulting Engineer" and "The Consulting Engineer in the Field of Foreign Investment." There was general agreement that there is less call than formerly for the services of the consulting engineer, but that a wide future should be opening for the consultant to advise the banker on foreign investments. The circular sent to bankers by the institute in the autumn, pointing out the function of the consulting engineer in passing on projects had had, so the members reported, a favorable reception.

Jersey Engineers Study Future Traffic

An investigation is being made under the direction of the New Jersey State Association of County Engineers into the question of probable future traffic on county and state roads, with a view to planning for such traffic. J. C. Bauer, Elizabeth, chairman; A. H. Nelson, Atlantic City, secretary; J. J. Albertson, Camden; T. J. Wasser, Jersey City; J. M. Abbott, Toms River; F. A. Reimer, Newark, and Harry F. Harris, Trenton, have been appointed a committee to obtain information on the matter.

A questionnaire has been sent to all the state highway departments throughout the Union, members of automobile associations, and county engineers in New Jersey and many other states. It has been found that in many sections traffic has doubled during the past two or three years, and that some of the highways are inadequate to handle the traffic. It is said that some of the highways will be restricted to slow-moving vehicles and others to passenger cars. The questionnaires will afford deciding information.

Motor Transport Economics, Theme of Week's Conferences

As a climax to a series of conferences given in connection with the motor truck show at the 8th Coast Artillery armory, New York City, where every angle of the economics of highway transport received attention, the afternoon session on Saturday, Jan. 10, was given over to a discussion of the influence of so-called durable pavements upon motor truck haulage costs. During the week of conferences farmers, truck manufacturers and dealers, those connected with motor express companies and those interested in highway construction specifically and highway transport generally met and discussed methods determining wherein the field for highway transport lies, what its limitations are and to what extent highway departments can economically go in the construction of so-called "durable types" of pavement for the better accommodation of motor vehicle traffic.

That there is strong necessity for elaborate extension in motor express haulage was a fact generally enunciated, some speakers even predicting within a few years the "farm-to-housewife" truck with its burden of farm produce. A view of the immensity of the field for motor truck use was revealed in several discussions, notably that of Senator Arthur Capper, of Kansas. The afternoon sessions during the entire week were devoted to discussions of first interest to manufacturers and dealers in motor trucks. Evening sessions were given over to discussions upon all phases of highway transport.

In the closing session H. Eltinge Breed, consulting engineer, New York City, reviewed progress in road construction ending with a plea that the public insist, through pressure brought to bear on state legislatures, upon sufficient appropriation of funds for building bridges of adequate capacity. He asserted that bridges had lagged furthest in highway work because they were not considered an integral part of the highway system, and that frequently highways were designed to sustain heavier traffic than the bridges connecting them.

Interesting data were brought out in talks upon motor truck operating costs by Prof. Arthur H. Blanchard, head of the Highway Engineering Department of the University of Michigan, and M. O. Eldridge, director of roads, American Automobile Association Good Roads Board. Citing a recent survey conducted by the bureau of crop estimates indicating that the average cost of hauling by wagon in the United States over all classes of roads was about 33c. per ton-mile, while by motor truck it was about 15c. Mr. Eldridge came to the conclusion that if the main highways of the country over which the bulk of the traffic is carried were hard surfaced so as to permit of the economic operation of motor trucks, the highway transportation bill of the United States could be reduced by at least 50 per cent. He also suggested that figures compiled by the chief engineer of the Colorado State Highway Commission, made it appear that a saving of 10c. per ton-mile in the cost of hauling any class of freight would save in two years, for a road on which the traffic will average 150,000 ton-miles per year, sufficient money to pay the cost of construction at $30,000 a mile.

In speaking of the highway which the ever-increasing motor traffic will demand in the future, W. G. Thompson, state highway engineer of New Jersey, asserted that, whereas he was making no recommendation as to the type of paving that should be laid, the needs of the future should be the basis of construction of both highways and highway bridges. He asserted that the highway engineer was more or less in the dark concerning highway construction, that his position was not at all analogous to that of the automotive engineer, for the highway engineer has no precedent to guide his design and in his work there are no cross-sections constructed for specific loads. Mr. Thompson asserted that the type of pavement to be selected was always a matter of local determination. However, he did recommend a graded width of 30 ft. for four lines of traffic on main traveled highways; that particular attention should be paid to subsoil drainage and any expense in securing as near perfect drainage as possible was justified. His discussion ended with a plea that the general public educate itself to the specific problems before the highway engineer so that adequate legislation would result, so that highway departments would not be subjected to the vicissitudes of partisan politics, and that existing conditions would be changed so that public service would be more attractive to capable men.

Colorado Proposes Three State Railway Tunnels

Public financing of three long tunnels in Colorado to reduce present open-pass summit elevations of railways crossing the mountains is advocated by the State Railroad Commission in a report to Governor Shoup. The tunnels proposed are as follows: On the Denver & Salt Lake R.R. near James Peak, 6.4 mi. long, at an elevation of 9,100 ft.; near Marshall Pass, 6 mi. long, elevation 9,500 ft.; and a shorter tunnel near the Cumbres Pass. The present maximum grades of 3 per cent to 4 per cent could be reduced to 2 per cent.

In view of the time required in construction, the Commission recommends that work should be begun at once and prosecuted vigorously and without interruption. The railways concerned are in the hands of receivers and private financing seems improbable within the near future. It is recommended, therefore, that bonds should be issued to provide for the construction of these tunnels and that an amendment to the State constitution to provide for such a bond issue should be submitted to the voters at the next election.

Chamber of Commerce Referendum on U. S. Public Works Department

In response to a request of Engineering Council, the U. S. Chamber of Commerce has appointed a special committee to consider the advisability of submitting to referendum of the chambers of commerce throughout the country, the question of a National Public Works Department. The members of the Chamber's committee are: Charles Nagel, St. Louis, Mo.; William C. Redfield, New York, N. Y.; R. G. Rhett, Charleston, N. C.; Ira N. Hollis, Worcester, Mass.; J. Parke Channing, New York, N. Y.; L. S. Gillette, Minneapolis, Minn.; Morton G. Tuttle, Boston, Mass.; Walter S. Dickey, Kansas City, Mo.; F. A. Seiberling, Akron, Ohio.

This committee held a meeting Jan. 19, in the Washington offices of the National Chamber and to present to it arguments for a National Public Works Department, Engineering Council has appointed a special committee of engineers. The members of Council's committee are: Isham Randolph, Chicago, Ill.; D. Knickerbacker Boyd, Philadelphia, Pa.; Leonard Metcalf, Boston, Mass.; General R. C. Marshall, Washington, D. C.; M. O. Leighton, Washington, D. C.; L. W. Wallace, Baltimore, Md.

Reports from various parts of the country indicate that business men as well as engineers, architects and contractors, are taking an interest in the proposal to establish a National Public Works Department.

Engineering Council has been for some time a member of the United States Chamber of Commerce.

American Waterworks Association Nominations

The nominating committee of the American Waterworks Association has presented the following nominations: For president, Beekman C. Little, Rochester, N. Y.; for vice-president, Edward Bartow, Urbana, Ill.; treasurer, J. Walter Ackerman, Auburn, N. Y.; for trustees, District 2, Harry F. Huy, Buffalo, N. Y.; and District 5, Robert J. Harding, San Antonio, Tex. In accordance with the constitution, additional names may be placed in nomination on petition of 25 members, the final voting for officers to take place two months before the annual convention.

Bill for New Railroad in Quebec

A bill for the formation of the Quebec Colonization Railway Co. has been introduced in the legislature of Quebec. The company is seeking authority to construct a line from Mont Laurier to Maniwaki, and from Lake Expanse and Lac des Quinze to Temiskaming, from a point in Pontiac County to Nottaway and from Bell River to Lake Shabogame. At this writing the organizers of the company are not known.

Engineering Institute Will Hold Convention in Montreal

The annual business and professional meeting of the Engineering Institute of Canada, will be held at the Institute quarters, Montreal, Quebec, on Jan. 27, 28 and 29. Papers dealing with the existing commercial, industrial and financial problems of the province will be delivered, as well as with its water-powers, both developed and undeveloped, its highways, its forest products and a general survey of its commercial potentialities.

It has been felt that heretofore the work of the members of the engineering profession has not appeared before the public in its true perspective, and an endeavor is, therefore, to be made to acquaint the public with the scope and importance of the work done by engineers in developing the natural resources of the country. On the opening day the retiring president, Colonel Leonard of St. Catherines, Ont., will deliver his valedictory address. He will be followed by the in-coming president, R. A. Ross, who will formally address the members.

Among the technical papers are the following: "Quebec's Water-Power Policy and the Work of the Quebec Streams Commission," by Olivier Lafebvre, chief engineer Quebec Streams Commission; "The Operation of the Quebec Public Health Act," by Theo. J. Lafreniere, chief sanitary engineer to the Superior Board of Health of the Province of Quebec; "Quebec Highways," by Alex. Fraser, assistant chief engineer Quebec Department of Roads. In addition to these papers it is expected that there will be an address at the luncheon on Jan. 27 by E. W. James, assistant chief engineer Bureau of Public Roads, Washington, entitled, "Modern Highways Problem."

Limitation of Earnings Taken Up by Rail Conferes

With the ranks of the railway executives still split on the distribution and limitation of "excess earnings," the joint conference committee on the Cummins and Esch railroad bills last week began discussion of this feature, with testimony from members of the Interstate Commerce Commission, including Commissioners Clark, McChord and Hall.

Commissioner Clark favored the minimum return feature of the Cummins bill and accepted the excess income reduction feature as unavoidable, expressing confidence that the plan would be successful, in the main coinciding with Commissioner Hall's views. In the opinion of Commissioner McChord, the rate plan of the Cummins bill would seriously disturb present rate structures. The thought was expressed that this phase of the law would be the first taken into the courts. No vote on the question has been taken by the conferes up to this writing.

Previous to the testimony of members of the Interstate Commerce Commission an opinion was filed with the Conference Committee by Elihu Root, John G. Milburn, and others, as advisory counsel for the Security Holders Association in answer to statements made by T. De Witt Cuyler and A. P. Thom, chairman and counsel of the Association of Railway Executives, in regard to the provisions of the Cummins bill providing for the limitation and distribution of "excess" earnings. The opinion stated that the principle is not novel, but can be substantiated by legal precedent, and referred to a number of Supreme Court decisions. The division of opinion on this question in the Association of Railway Executives appears still to exist, although the representatives of the "strong" systems seem to control the situation.

Large Delegation at Washington Urges Reclamation Policy

Headed by seven governors and the personal representatives of several others a large delegation of Western and Southern officials and business men spent most of the week ended Jan. 17 in Washington, urging that a Federal reclamation policy be adopted.

Various hearings were arranged and every facility accorded the visitors to get their desires before the nation's law makers. The Western men are urging that $250,000,000 be made available by the present Congress for the completion and building of irrigation plants which have been examined and found feasible by the Reclamation Service. The Southern delegates are interested largely in the reclamation of swamp land.

It was pointed out that since the signing of the armistice we have loaned Europe $2,500,000,000. That action has the approval of the delegates but they see no reason why a small fraction of that sum cannot be loaned to Americans when the object is to add to the productivity and wealth of the nation.

In addition to making their desires known to a large number of individual members of the Senate and of the House of Representatives the delegates went to the heart of things by putting their demands squarely before the steering committees of each House. They received encouragement at every hand and while the probabilities are against their receiving all they ask, it is certain that the visit has given new stimulus to reclamation. The governors who accompanied the party were those of Arizona, New Mexico, Utah, Idaho, Washington, and Wyoming. Former Governor William Spry of Utah, Lieutenant Governor Stephan of Colorado and Lieutenant Governor McDowell of Montana, also were with the party. J. T. Whitehead of Nebraska, S. J. Rogers of Navada, W. A. Beard of California, R. F. Burges of Texas and Whitney Boise of Oregon were the personal representatives of the governors of those states. Thirteen members of the executive committee of the Western States Reclamation Association, picked because of their personal knowledge of irrigation, formed a part of the delegation.

Propose an Engineering Building for San Francisco

The Engineers' Club of San Francisco has appointed an engineering building committee which is preparing a report on the plan of getting "all the engineering interests of the city together under one roof." The investigation is to determine whether the engineering professions and trades have sufficient common interest in such a plan to warrant the committee in drawing up a definite proposition for prospective building owners.

General discussion of the idea at society and committee meetings has materialized into a suggestion that the building have 10 or 12 stories, the two top floors to be occupied by the engineers' club, the body of the building to be arranged for offices of engineers, the technical papers, and of merchants dealing in engineers' equipment, supplies and materials. The suggestions include providing an auditorium large enough for joint meetings of the engineering societies. The first action of the committee was to circularize all engineers of San Francisco asking for a statement as to whether they would be interested in rental space in such a building located in the vicinity of the Palace Hotel, what floor space each one occupied and what maximum price per square foot could be considered. When the returns from this letter have indicated the general sentiment, further plans will be discussed, and formulated accordingly.

Civil Service Examinations

New Jersey. Deputy chief engineer, Department of Streets and Public Improvements, $6,000 per year, Jan. 28. File application with State Civil Service Commission at Trenton.

California. Assistant state engineer, $3,000 per year (statutory), examination to be held Feb. 7 in Sacramento, San Francisco and Los Angeles. File application before Feb. 1.

United States

For United States civil service examination, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission, for form 1312.

Chief of Road Survey Party, $1,800 to $2,100 per year. File application before Feb. 10, 1920.

Transitman for road survey, $1,200 to $1,800 per year. File application before Feb. 10, 1920.

Highway draftsman, $1,200 to $1,800 per year. File application before Feb. 10, 1920.

Topographic and subsurface draftsman, Grade 1, $5.20 per day; Grade 2, $6 to $7.20 per day. File application before Jan. 27, 1920.

Ceramic assistant, to fill a vacancy at the Ceramic Experiment Station in the Bureau of Mines, Columbus, Ohio.

$1,200 to $1,800 per year, and to fill vacancies in positions requiring similar qualifications. File application before Feb. 10, 1920.

Canada

The Civil Service Commission of Canada will receive applications from residents of Canada, qualified to fill the following positions:

Shipyard superintendent, Sorel, P. Q., salary $3,000.

Foresters, salary $1,680.

Junior engineers, initial salary $1,680.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA; General Secretary, Fraser S. Keith, 176 Mansfield St., Montreal; Jan. 27-29, Montreal.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, 247 W. 54th St., New York City; Jan. 29, Chicago.

AMERICAN ROAD BUILDERS' ASSOCIATION, 150 Nassau St., New York City; Feb. 9-13, Louisville, Ky.

AMERICAN WOOD-PRESERVERS' ASSOCIATION; Secretary-Treasurer, F. J. Angier, Mt. Royal Station, Baltimore; Feb. 10-12, Chicago.

AMERICAN CONCRETE INSTITUTE; Secretary Harvey Whipple, New Telegraph Bldg., Detroit; Feb. 16, 17, 18, Chicago.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; 111 W. Washington St., Chicago; Feb. 18-19, Chicago.

AMERICAN CONCRETE PIPE ASSOCIATION; 210 South La Salle St., Chicago; Feb. 20-21, Chicago.

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 1426 Manhattan Bldg., Chicago; March 16-18, Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; Secretary C. E. Drayer, 29 S. La Salle St., Chicago; May 10, 11, St. Louis, Mo.

The Northwestern Association of Members, Am. Soc. C. E., met Jan. 6 in St. Paul, Minn., to continue a discussion of the Development Committee's report. The findings and recommendations of the committee were approved with some slight changes, but the included report of the Joint Conference Committee on a comprehensive organization of the engineers of the country was not approved, and a delegate was appointed to attend the annual meeting and oppose the plan of representation in the National Organization as outlined therein, the prevailing opinion of those present being that the Joint Conference Committee's report would not be approved at the annual meeting. A committee of five, with Francis E. Shenehon as chairman, was appointed to draw up a substitute scheme for a national organization to handle non-technical and welfare activities, which scheme might be offered at the parent body's annual meeting.

The Minnesota Joint Engineering Board will hold its annual meeting and dinner for all engineers of the nine affiliated engineering societies in the state Feb. 21, 1920, in Minneapolis, Minn.

The Board of Direction of the Minnesota Engineers' and Surveyors' Society met in Minneapolis, Minn., Jan. 8, to plan the Society's annual meeting which will be held Feb. 19, 20 and 21 in that city. The first day of the session will be devoted to a discussion of the Babcock Good Roads amendment. All road engineers of the State Highway Commission, who will be called in to attend a school of road instruction on the 17th and 18th, will participate with the Society in this discussion. The mornings of the second and third days will be given over to meetings of the Drainage, the Municipal and the Railroad Divisions of the Society. The second afternoon session will be devoted to a discussion of the uniform license law for engineers and architects as reported by Engineering Council's Committee on Licensing Engineers, and of the proposed National Public Works Department.

The Engineers' Society of Milwaukee held its monthly meeting in Milwaukee Jan. 14. The feature of the meeting was an illustrated address by Max Rotter, consulting engineer for the Busch-Sulzer Bros. Diesel Engine Co. of St. Louis. His subject was "Diesel Engines With Particular Reference to Recent 2-Cycle Types."

The Engineers' Club of Trenton held its annual smoker in its club rooms in Trenton, N. J., Jan. 15. The function was marked by the inauguration speech of President-elect Alfred P. S. Bellis, and an address by the retiring president, Charles R. Fairchild.

The Rochester Engineering Society not only has a thorough appreciation of big national engineering issues but it has, as well, the faculty of getting behind and pushing. Following is the text strikingly displayed on a small card bearing a money-forwarding coupon and sent to all members of that society: "Rochester Engineering Society: Important! To the members who have not already contributed: The campaign for the establishment of a National Department of Public Works has 'caught on' to such an extent that a second convention has been called to meet in Washington, D. C. this month. The engineers and architects started this movement and we now have the bear by the tail. If we let go, the bear will turn on us and scratch our reputation as doers of things. Climb down from the grandstand and get into the game. Send in your dollar now to Louis J. Summerhays, treasurer, 1 Exchange St."

The Western Society of Engineers was, on Jan. 19, addressed in Chicago by M. J. Faherty, president of the Board of Local Improvements, on "Chicago Municipal Improvements," a paper concerning the cost and value of various street improvements. Coming meetings include papers as follows: By John F. Hayford, dean of the college of engineering, Northwestern University, Feb. 2, on "Development of the Civil Use of the Aëroplane"; by C. P. Winslow, director, on "The Work of the Forest Products Laboratory"; by Wharton Clay, commissioner of the Expanded Metal Manufacturers' Association, on "The Engineer in Trade Organization Work"; by J. S. Conway, deputy lighthouse commissioner, on "The U. S. Lighthouse Service," and by Grant Beebe on "Secondary Technical Education."

The American Association of Engineers has authorized the appointment of a committee on the salaries of engineers in teaching service. C. J. Tilden, professor of engineering mechanics at Yale University, has accepted the chairmanship.

The Ohio Engineering Society is holding its forty-first annual meeting in Columbus, Ohio, beginning Jan. 21 and ending on the 23rd. Seventeen papers or addresses are on the program.

PERSONAL NOTES

COL. F. B. MALTBY, formerly Section Engineer, Base Section No. 1, under the Director of Construction and Forestry of the A. E. F. in France, was recently decorated with the cross of the Legion of Honor by General Goldet of the French high commission at Washington, in recognition of his services in port improvement, water supply and general construction. Colonel Maltby had his headquarters at St. Nazaire while in France; he recently secured his discharge from the Engineers, U. S. Army, and takes passage this month for Liberia, where he will make harbor works estimates for J. G. White & Co., of New York City.

VERNON H. TAGGETT of Morrison, Ill., for six years superintendent of highways of Whiteside County, Ill., will be the road building engineer for Emmet County, Mich., at a salary of $3,300 per year. He will report for duty Feb. 1.

WILLIAM J. CARTER, for several years engaged in the private practice of engineering and architecture in Cleveland, Ohio, has formed, with F. D. Richards and F. M. Griffith, the firm of Carter, Richards, Griffith Co. to conduct a similar and more extensive business in that city. Mr. Richards is a former city bridge engineer of Cleveland.

WM. CLAER SPIKER, for ten years consulting engineer in reinforced concrete and structural steel work in Atlanta, Ga., has taken into a partnership Robert G. Lose, former engineering instructor in Carnegie Institute of

Technology and consulting engineer in Pittsburgh, Pa. Mr. Spiker was in charge of the design of several of the Government concrete ships and in part of that work Mr. Lose was his principal assistant and his successor upon his resignation.

DONALD M. HEPBURN, engineer in charge of extensive Government construction at Hog Island, was appointed, on Jan. 15, chief of the Philadelphia Bureau of Street Cleaning by John C. Winston, that city's Director of Public Works.

PROF. ROBERT C. TERRELL, acting director of the department of civil and highway engineering at the University of Olkahoma, has been appointed State highway engineer of Oklahoma, to succeed Max L. Cunningham. The new appointment is effective Feb. 1. Prof. Terrell is a graduate of the University of Kentucky and was Commissioner of Public Roads of Kentucky from 1912 to 1916. Since 1916 he has been a member of the faculty of the University of Oklahoma.

C. H. KOYL, engineer of water service of the Great Northern R.R., has been appointed to a similar position with the Chicago, Milwaukee & St. Paul R.R.

C. A. BINGHAM, civil engineer, will assume his duties as city manager of Watertown, N. Y., Feb. 1, 1920. For the past five years Mr. Bingham held a similar office in Norwood, Mass.

OLIVER T. REEDY, M. Am. Soc. C. E. and for seventeen years engineer on design and construction with the United States Reclamation Service, announces the opening of an office for service as consulting civil engineer in the Century Building, Denver, Col. His specialties will be irrigation, drainage, water supply, dams, tunnels, reinforced concrete, investigations, reports, designs.

A. M. DAVIDSON has been promoted to be assistant division engineer of the Baltimore & Ohio Western Lines with headquarters at Cleveland, Ohio, according to an announcement of E. G. Lane, the Railroad Administration's chief engineer for those lines.

BRUCE L. CUSHING has resigned as designing engineer of the Acheson Graphite Co., Niagara Falls, N. Y., and become associated with Cundall, Powell & Mosher, Inc., consulting engineers of Buffalo.

GEORGE E. CHAMBERLIN, for several years in charge of Stone & Webster's construction operations in the steel plant district of Ohio, and more recently in charge of that company's Chicago office, has been transferred to Cleveland where a new district office is to be located.

GEORGE R. PUTNAM, commissioner of lighthouses, and John C. Hoyt, of the U. S. Geological Survey, both of Washington, have been elected president and vice-president respectively of the Cosmos Club, Washington.

Trailer Industry Discussed in Annual Meeting

At the first annual meeting of the Trailer Manufacturers' Association of America, held in New York City, Jan. 8, new officers were elected and work of the past year was reviewed and it was decided to continue along the same lines in 1920. The desirability of standardizing the load rating of semi-trailers and pole trailers was agreed upon, and the association's general manager was instructed to secure the views of all members as to the best method. The Trailer Association voted to apply for membership in the Chamber of Commerce of the U. S., and in the Federal Highway Council.

Addresses on short-haul and terminal transportation, and on patent matters, were delivered by C. W. Reid of the Federal Highway Council, and R. A. Brannigan of the National Automobile Chamber of Commerce. There was also a paper on advertising by H. Colin Campbell of the Portland Cement Association.

BUSINESS NOTES

J. A. GRANT and JAMES GILCHRIST have incorporated as J. A. Grant & Co., Ltd., with head offices at St. John, N. B., to take over the expanded engineering, contracting and shipbuilding business of Grant & Horne in the Canadian Maritime Provinces. Mr. Grant received his technical education and early training in England. From 1908 until 1916 he has been in charge of many large works in Canada. The last four years of his time have been spent in the business of Grant & Horne, and in consulting work at Toronto harbor. He is an associate member of both the Canadian, and American, Soc. C. E. Mr. Gilchrist is an associate member of the British Inst. C. E. He was educated as an engineer in Scotland, practiced his profession from 1899 to 1911 in Scotland, England and the Straits Settlements, principally in the design and supervision of large marine works. Since the latter year he has been in charge of harbor and ship construction.

BARCLAY PARSONS & KLAPP announce the change of the firm name to Parsons, Klapp, Brinckerhoff & Douglas, the personnel, William Barclay Parsons, Eugene Klapp, Henry M. Brinckerhoff and W. J. Douglas, remaining unchanged.

THE EDMUND T. PERKINS ENGINEERING CO., consulting and supervising engineers and specialists in land reclamation, announces the centralizing of all its branch offices at 1210-56 First National Bank Building, 38 So. Dearborn St., Chicago, Ill.

F. C. HUYCK & SONS of Albany have contracted with the Massachusetts Institute of Technology for consulting advice in accord with the latter's plan for raising an educational endowment fund.

BEN HAISLIP, who for the past four years has been connected with the Chicago office of the U. S. Rubber Co. as sales engineer, has joined the sales organization of the Traylor Engineering & Mfg. Co. of Allentown, Pa., makers of the "Bulldog" jaw and gyratory crushers, Traylor heavy duty crushing rolls and cement mill and smelting plant equipment. Mr. Haislip, who from 1904 to 1905, was with the Allis-Chalmers Co., and from 1905 to 1916 with the Power & Mining Machinery Co., will be connected with the Chicago District Office of the Traylor Co. in the capacity of sales engineer and assistant to L. J. Hewes, district manager.

R. S. DIMOCK and CHAS. R. GODDARD, the latter formerly with the R. H. Howes Construction Co., New York City, and George Waterhouse of the George Waterhouse Co., Beaufort, S. C., announce that they have incorporated as the General Construction Co., with principal office at Savannah, Ga.

Convention of Material-Handling Machine Makers

What is intended to be a two-day "get together" for all manufacturers of machinery, accessories and equipment used in handling material is to occur in an open convention of the Material Handling Machinery Manufacturers' Association in New York City, Feb. 26 and 27.

In addition to its large membership the association is anxious to have present manufacturers from any part of the country who make cranes of any kind, hoists, winches, portable, gravity, and power conveyors, industrial trucks, tractors and trailers, bulk handling machinery, elevators, motors and electrical control apparatus, batteries, ball-bearings, wire and manilla rope used in the construction of mechanical handling machinery, hand lift trucks, etc. A blanket invitation has been issued for the attendance of representatives of all manufacturers who make machinery or equipment for machinery which handles raw products, parts in process and finished products, by mechanical movement rather than by manual physical labor.

Details of the program are being completed and arrangements have been made to hold a morning business session on Feb. 26, followed by a formal luncheon, with a prominent speaker, and an afternoon session in which short papers on mechanical handling will be read followed by open discussion and moving pictures. The morning of Feb. 27 will be devoted to an executive session of the membership and the afternoon will be a continuation of the papers and discussion on mechanical handling followed by a moving picture program of a number of the latest and largest installations.